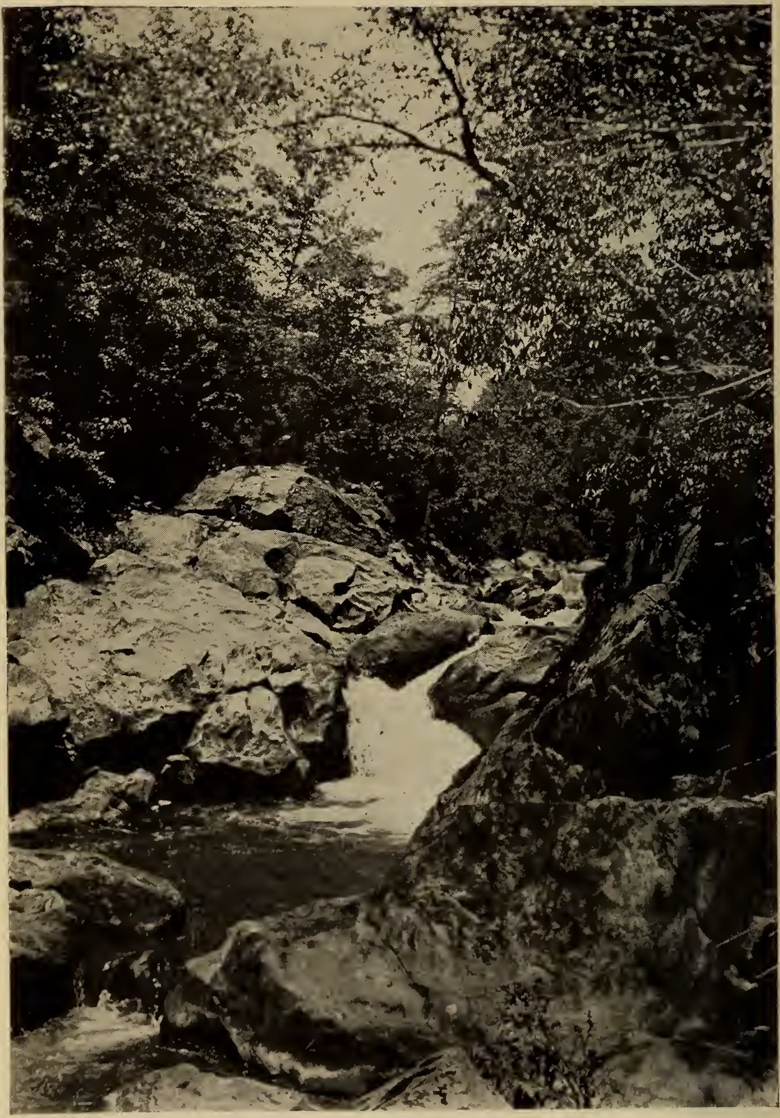

IN THE DRUG COUNTRY

A Characteristic Detail in the Piedmont

The Century Books of Useful Science

THE STORY OF DRUGS

A POPULAR EXPOSITION OF THEIR ORIGIN, PREPARATION AND COMMERCIAL IMPORTANCE

BY
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ILLUSTRATED WITH PHOTOGRAPHS

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INTRODUCTION

The presentation in popular form of facts of interest connected with the production of medicines is timely, because of an increasing desire on the part of the layman for a deeper insight into scientific and professional subjects generally, and because of the many fallacies and erroneous beliefs that have hitherto prevailed regarding the various phases of the drug business. When discussing the character of drugs and their properties with the average non-scientist, one is immediately struck with the fact that a mental confusion prevails as to what medicinal agents really are, where they come from, and how far they may be reasonably expected to go in alleviating the diseased conditions to which humanity is susceptible.

In the course of a year the specialist, if he is known to be familiar with a branch of science involving the public welfare, will be called upon to answer a thousand or more questions, widely divergent in character yet pregnant with significance, and demonstrating the craving for knowledge displayed by civilization of the present day.

The topics and the subject-matter making up this volume have been inspired by the interrogations and discussions that a scientist, actively engaged in his profession, has encountered during two decades of almost daily contact with professional men of high and

low degree, and with the various zones of culture making up our citizen population.

The work is not intended as a scientific treatise; in fact, that is exactly what has been avoided. The object has been to present, as far as possible, in plain every-day terms and phraseology a story of the various phases of the drug industry, based, as before stated, on the diversified inquiries of non-scientific persons.

The book is divided into chapters; but, since the volume is a collection of expositions rather than a connected narrative, there has been no attempt to arrange the material in periodical sequence.

First there is a short outline telling what drugs are and where they originate. This is followed by a historical sketch of the development of the medicine-making industry. And finally there is a detailed account of how medicines are made.

The alcoholic question has set agog this nation as well as the entire world, and because of the many erroneous ideas prevalent about the significance of alcohol and alcoholic medicines, it has been deemed expedient to devote some space to defining the true status of alcohol in relation to the drug and medicine industry. Similarly, though perhaps to a lesser degree, the popular mind has been agitated by a vague knowledge of the dope evil, the extent of its effect, and the character of the offending agents. In view of the widespread interest in this subject, an account of what dope actually is, and is not, has been presented in such a way as to dispel many popular fallacies con-

cerning various drugs that at one time or another have been considered to possess habit-forming properties.

Several years ago agitation in the scientific and popular press produced such a widespread interest in drug cultivation that it appeared as if one person in every ten were planning to embark on this nebulous avocation. Fortunately for their bank accounts, the interest became more or less passive. A short account, based on personal observation of what is actually being done in the artificial propagation of vegetable drugs, defining the conditions existing at the present time, and dispelling the romantic visions of the enthusiasts, comprises the chapter "Farming for Medicine."

The extent to which the medical world depends on remedial agents of natural origin, with an account of the drug-collecting industry of our Southern mountain districts, has been made the subject of one chapter.

No other feature of the drug business has aroused and maintained the public interest to the same degree as the patent-medicine situation. No other phase of the entire industry has been so misunderstood and misrepresented. An endeavor has been made to point out the truth about patent medicines, to differentiate between the fake products and the legitimate old-line proprietaries, and to define the actual status of these household remedies in the economy of the nation.

Coincident with a discussion of popular remedies comes, naturally, a consideration of the general medi-

cal supplies kept in the home for treating numerous simple ailments, and the extent to which it is expedient to indulge in self-medication. In this connection emphasis has been placed upon the importance of prophylaxis, and the relation of insect and animal life in the spread of disease.

The growing importance of vaccines and serum-therapy makes it expedient to explain the characteristics and differences between antitoxins and vaccines or immunizing agents; and the advent of those mystical bodies known as vitamines, and the wide popular curiosity about them, would make any modern work incomplete without a short reference to their life histories in so far as it is possible to define them.

Not to confine the account too rigidly to drugs and medicines, a diversion has been made to include a short chapter on cosmetics and other beautifiers that function in the daily routine of women. These preparations now have an established place in our national life, and are no longer to be considered in the nature of luxuries, but as necessary adjuncts to the comfort and satisfaction of modern civilization.

That emotional malady, hay fever, which reflects the neurotic tendency of our national life, has ever been a fruitful subject of discourse. Its periodical recurrence, its transient discomfort, usually without permanent after-effects, and its stubborn resistance to remedial agents characterize it as an anomaly in the list of human ailments. Because of these facts and the popular interest in its manifestations, and furthermore because a new and rational mode of treat-

ment has come into prominence, it has been thought not out of place to devote a few words in its behalf in a book that is not, strictly speaking, a medical dissertation.

While the work was in process of compilation, a prominent attorney suggested the pertinence of including some observations on the effect of legislation on the manufacture and traffic in drugs and medicines, especially in view of the author's intimate association with administrative matters of this nature.

In certain respects the drug business has been virtually revolutionized in recent years, owing to the passage of far-reaching laws, such as the Food and Drug and Prohibition Acts, and the increasing activities of the authorities in the several commonwealths and municipalities. The brief outline of this subject that makes up the final chapter embodies the salient features occurring to an impartial observer of the reactions manifested by this important industry to the numerous regulations and restraints that have been imposed upon it in the past two decades.

Matters of a controversial nature have no place in a presentation of this kind, and, though the drug and medical cosmos teems with debatable questions, their inclusion would only warp the object aimed at, and they have been intentionally avoided.

Through a wide personal acquaintance in the professional and business world of drugs and medicines, the author has had a rare opportunity to obtain a wealth of data, both historical and informational, and

to the men who have so cordially extended their assistance his indebtedness is heartily acknowledged.

In order that the presentation might be comprehensive to the non-scientist and as free as possible from obscure technical phraseology, the paragraphs have been carefully perused by Mrs. Fuller, Mrs. Mulford, and a number of other friends of non-professional tendencies. Their suggestions and ideas have been the means of clarifying many descriptions that otherwise might have gone over the head of the reader.

The author's appreciation of their devotion to the work and the assistance rendered is gratefully acknowledged, as is also the task of assembling the data and transcribing the manuscript by Miss Ada Whipp, whose able coöperation has been the means of bringing the work to a prompt and successful completion.

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The Story of Drugs

THE STORY OF DRUGS

CHAPTER I

WHAT DRUGS ARE AND WHERE THEY COME FROM

The public has always shown considerable interest and curiosity about drugs and medicines. This is partly due to the shroud of mystery with which the family doctor and the corner druggist have veiled the character of the contents of bottles and powders that have found their way to the bedsides of almost all of us at sometime or other in our lives. The American people are keen for anything suggestive of a riddle, and the hieroglyphics with which a physician covers the face of a little slip of paper, later to be translated into a bottle of cough syrup or headache powder by the druggist, stir our imagination. We read with avidity any article dealing with the subject of patent medicines, regardless of its inaccuracy. We relegate for later consideration such subjects as the tariff and the latest revolution, while we peruse the column of the morning paper describing the dozen or so inebriates who have been captured the night before—sadly the worse, so the account goes, because of too intimate association with this "tonic" and that "hair wash";

and no daily paper is now complete without a section devoted to what Dr. Blank says.

The popular interest in drugs has of late years been stimulated by several factors, and more particularly by two, one of which was the publication of Mrs. Gene Stratton Porter's book, "The Harvester," the other the outbreak of the war in Europe. For most of us, the idea of obtaining anything from woods and fields and subduing it to cultivation has a keen fascination, and in the minds of many persons those drugs and medicines that do not come from "coal-tar" come from the forest. In the demoralization of ocean traffic that came with the war, the fact that the continued supply of many important drug commodities was seriously menaced became a matter of daily mention in the newspapers; and interest in the subject became almost universal. It possessed a certain element of romance, made excellent dinner conversation, and was discussed at almost any gathering where two or more people were assembled, much the same as prohibition later became the popular topic. Few persons, however, really knew enough about the subject to discuss it intelligently, and it was not uncommon for people to ask if aspirin grew on a bush, or to inquire how drugs could be grown in America when it was understood that Germany had them all patented.

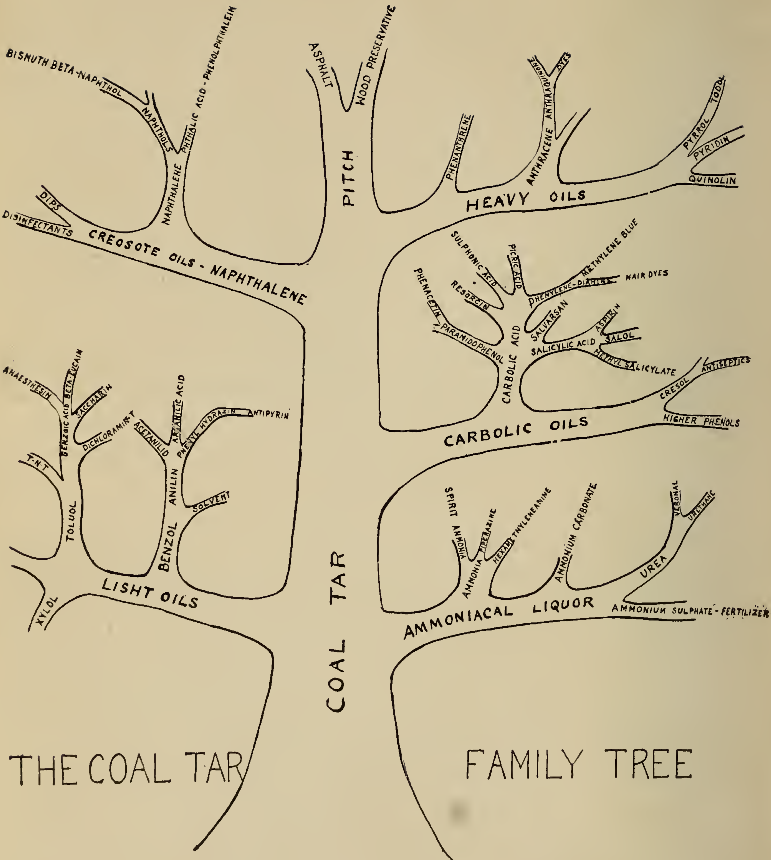
The term "drug," to some people, carries with it the idea of a narcotic—something taken to relieve pain or to put one to sleep—to be spoken of in an undertone, with a shrug of the shoulders. To others it means an individual chemical or a crude product that is used in preparing a medicine or in compounding a

DRYING A LEAF DRUG IN THE SUN

Coca Being Prepared for Market in Peru.
Photograph by O. F. Cook. Courtesy and copyright by National Geographic Society, Washington. D. C.

DRYING HOUSE WITH TRAYS FOR CURING DRUGS BY ARTIFICIAL HEAT

COMMERCIAL PACKAGES OF CRUDE DRUGS AS THEY OCCUR ON THE MARKET



"COAL TAR" DRUGS AND THEIR ANCESTRY

prescription. To still others it means any medicine; and this comes nearer to being a true definition of what a drug really is, for it is any substance or mixture of substances used as a medicine, or that enters into the composition of a remedial agent.

Before discussing the different classes of drugs, it will be expedient to note a few general points concerning the localities in which they originate, to counteract the popular notion that the United States is entirely dependent on foreign sources for its supplies. At the outbreak of the war the prevailing opinion seemed to be that Germany furnished us with the majority of our drug supplies. As a matter of fact, the Central Empires produced comparatively few individual staples; though the commerce in drugs that were collected or produced in northern Europe and Asia, and to a certain extent in Africa and South America, was centered in Hamburg. In other words, we depended on Germany for drugs to a considerable degree, not because they were produced there, but because they were brought there from all parts of the world, with Hamburg as the center of the export trade. Triest, also, was an important center for the articles collected in southern Europe and northern Africa. Therefore, when the ports of the Central Empires were blockaded, and supplies that had been coming here uninterruptedly for many years were suddenly shut off, it became necessary for American importers to make connections with dealers at the ports of origin.

An example of the control formerly exercised by the Germans is illustrated by the case of santonin, a popular remedy. This substance is a chemical individual,

the active principle of the levant wormseed or santonica. The plant producing the levant wormseed grows in the wildest parts of the Russian steppes, far from any seaport or commercial center, and this is the only place where it has grown profusely enough to be commercially important. Its value was long ago recognized by the Russian government, and so zealously did it guard its monopoly that no plants or viable seeds were permitted to leave that country. The plant is a species of artemisia, closely related to wormwood, or absinthe, and to the numerous species of artemisias that run wild on our Western plains and mountain-sides, but it is the only artemisia that contains santonin. The so-called "levant wormseed" is not a seed at all, but the immature flower or bud, about the size of a large mustard seed, and it is gathered before it expands. The concession to gather this "seed," and to extract the santonin from it, was formerly sold annually by the Russian government; and for years the Germans bought the rights, thus controlling the traffic.

Since 1914 London has to a large degree succeeded Hamburg as a drug center, and Marseilles also has become an important port of collection and shipment. Amsterdam has always been a drug center, partly because for many years the Dutch have controlled the trade in cinchona bark, the source of quinin, the value and volume of business of which is probably greater than that of any other individual drug, with the possible exception of opium.

There was another reason for the popular conception of Germany's monopoly of the drug field. Some

two decades ago there began to pour out of that country a great variety of so-called coal-tar products, some of which were of considerable merit as remedial agents, and are still extensively used. The development of substances of this nature was due to the fact that the German universities were specializing in chemical research and the problem of synthesizing quinin was receiving a great deal of attention.

In the course of this experimental work many new substances were produced, among them several well known chemical individuals, such as antipyrin, antifebrin, phenacetin, and aspirin. The commercial production of these coal-tar products was fostered by the Germans by means of the coöperation existing between certain basic industries of that country—namely, those concerned with the manufacture of dyes, explosives, and alcohol. In this coöperation for the advancement of German industry and trade as a whole, the new substances, as fast as they were evolved, were protected by patents at home and abroad, thus establishing the monopoly in their trade.

The commodities used as remedial agents, and which enter into the composition of the vast number of complex formulas dispensed by the physician and sold at the apothecary's, are divided into several different classes, belonging to two large orders familiarly known as inorganic and organic. There are metals, salts, and similar chemicals which in chemical language we refer to as inorganic substances, and which are represented by mercury, iodine, sulphur, iodide of potash, chlorate of potash, the bromides, sodium phosphate, calomel (a salt of mercury), bichloride of mer-

cury, hydrogen peroxide, bismuth salts, boracic acid, carbonate of iron (used in Blaud's mass), magnesium sulphate (epsom salts), ammonium chloride, and many others, all of which have been manufactured in this country for many years.

Then, there is a large class of drugs composed of the three elements carbon, hydrogen, and oxygen, united in different ways, the nature of which is very complicated, and others containing those three elements together with nitrogen, which as a general proposition do not occur naturally, but are manufactured, and are therefore usually spoken of as synthetics. These belong to the great order of chemical individuals known as the organic series. (It might be said, in passing, that numerically by far the larger proportion of all crude drugs and active principles used in medicine belong to this order.) Some though by no means all of these are the "coal-tar derivatives" to which reference has already been made. Among the organic compounds should be mentioned glycerin, novocain, carbolic acid, antipyrin, phenacetin, salvarsan, chloroform, chloral, iodoform, and aristol, though the four latter substances contain in their make-up certain elements—namely, chlorine in the first two, and iodine in the latter—which are, strictly speaking, elements of the inorganic branch of the family. Most of these substances were being made in this country prior to our entry into the World War.

Another large and very important group embraces the products of the vegetable kingdom which are themselves used as drugs, or which contain valuable principles that may be extracted and purified. The parts

of the different plants entering the trade may be leaves, roots, barks, seeds, juices, resins, gums, the whole herbs themselves, or fungous growths that live on the plants. Thus we have the leaves of the belladonna, digitalis, coca, and senna; the roots of mandrake, aconite, rhubarb, sarsaparilla, and gentian; the barks of the cinchona and cascara; the seeds of nux vomica; the juices of the aloes and of the poppy, the latter being known as opium; the resin of Canada balsam, guaiac, and asafetida; the balsams of the tropical trees known as Peru and tolu; the gum of acacia; the whole herb of boneset; and the fungus of the rye head, known as ergot.

The valuable principles yielded by these botanical drugs all belong to the organic order of chemicals. Some of the more important active principles are strychnin, which comes from nux vomica; morphin from opium; atropin from belladonna; cocain, from coca; and quinin, from cinchona. Caffein is another valuable medicine extracted from a vegetable substance, in this case tea dust or sweepings being the crude material. It is brought here from China by the shipload, and the caffein extracted therefrom goes into headache mixtures and the ever-increasing popular beverage, Coca Cola and similar soda-fountain drinks. Camphor is obtained from the branches and twigs of the camphor-laurel, a large tree growing in southern China and Japan; and menthol is frozen out of peppermint oil, the latter being distilled from a variety of the herb indigenous to Japan.

Mention should also be made of castor oil, which is expressed from the seed of the castor-bean. Several

large firms devoted to this industry are within our boundaries. The seeds are gathered in India and sent to America by the shipload. Between 1860 and 1890 the castor-bean was an important crop in some of our Southwestern States, but in recent years, except for a brief period during the war, its cultivation has been virtually abandoned. During the war there was a great demand for castor oil as a lubricant for air-plane motors. Chaulmoogra oil, which has been used for some time, though only recently featured as a remedy for leprosy, is a butter-like substance expressed from the seeds of certain trees growing in Burma and adjacent territory. The extraction and purification of most of the active principles just mentioned has been carried out in this country for a great many years.

A few important medicinal agents are derived from the animal kingdom, notably cod-liver oil, pepsin, adrenalin, diphtheria antitoxin, and vaccine.

An attempt has been made to classify the staple drugs with which most of us are acquainted. A large proportion of the trade in medicines is concerned with those named or with preparations containing them. There are thousands of others that might be noted. Certain firms making specialties consume enormous quantities of some one commodity which may be but a small factor in the business of all the other firms in the trade. Ginseng, which is produced in great volume in this country, is used here scarcely at all, most of it being shipped to China and other Oriental countries.

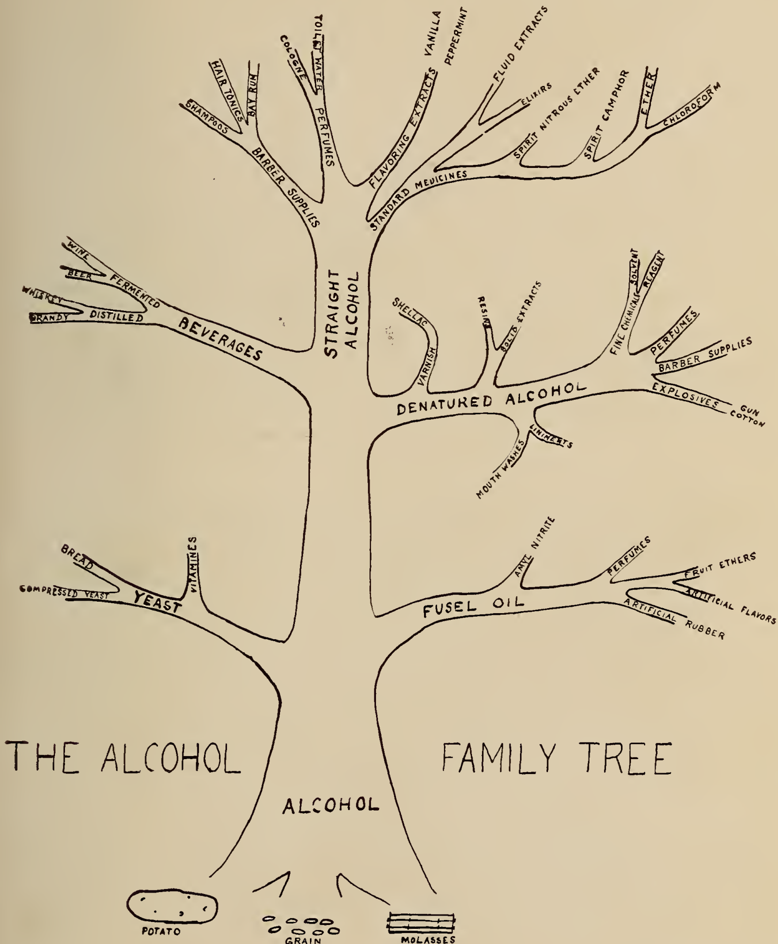
It will be interesting to make a brief survey of the

geographical sources of some of the drugs. As has been observed, we draw our supplies from all of the natural kingdoms, animal, vegetable, and mineral, and the basic products or crude materials are taken to the collection centers and refining establishments from the mines, from the prairies and forests, from the seashore, and from packing plants and slaughter-houses. The supplies of bismuth, a brilliant, shiny, and very heavy metal which eventually is converted into the well known salts of that metal, the subcarbonate and subnitrate, are all obtained from vast mineral deposits in widely separated localities, one of which is in Austria and the other in Ecuador. The commerce in this metal has been monopolized for many years, and the group controlling the mines has until very recently successfully prevented any competition, arbitrarily raising or lowering the price of bismuth, and in consequence its salts. Within the past decade, however, the recovery of bismuth as a by-product in the lead refineries of our Middle Western States has opened up a new source of supply of this metal, and the monopoly so long enjoyed by the foreign syndicate has been seriously menaced.

Almost as complete as was the bismuth monopoly has been the monopoly in the trade of iodine, which is the basic element used in the manufacture of the iodides, iodoform, tincture of iodine, and the many hundreds of medicinal preparations depending on some form of iodine as one of the essential ingredients. Iodine occurs in the salt deposits of Chile in the form of its sodium or potassium salt, the latter being separated out when the nitrate (saltpeter) is

refined. From this crude sodium or potassium salt the element iodine is prepared. The only competition has been the iodine manufactured from the enormous acreages of giant kelp, a seaweed growing profusely in the vicinity of Japan and the British Isles. The burning of kelp and the subsequent recovery of iodine has not been a large factor in British industry for some time, but the Japanese product has been an important element in the trade, and though the Chilean iodine might be marketed at a price that would be less than the cost of the manufacture of the seaweed product, the controlling interests in the Chilean iodine have usually kept the price at a figure that was high enough to allow the Japanese to sell at a fair profit. The business in the sale of both bismuth and iodine has for years centered in London.

Mercury, the metallic element of calomel and bichloride, and one of the heaviest known substances, is a liquid that is smelted out of the cinnabar ores mined in California, Texas, and Sicily. Antimony, one of the basic components of tartar emetic, is mined in China, and from there shipped to this country in the form of black needles of antimony sulphide. Arsenic, which as the white oxide enters into the composition of pills of iron, arsenic and strychnin, and many hundreds of other formulas, as well as Fowler's solution, is now a by-product in the smelting of copper, gold, and silver. Large and increasing quantities, more than sufficient for our entire needs in medicine, are produced in the United States. Boracic acid is prepared from the crude borax which is hauled out of Death Valley by the justly famous "Twenty-Mule



THE RELATION OF ALCOHOL TO THE MEDICINE INDUSTRY

A FIELD OF THE OPIUM POPPY

HOW FOREIGN DRUGS ARE SHIPPED

Bales of Sarsaparilla from Honduras

Team'' and is therefore a product of domestic manufacture.

Dolomite, the mineral from which epsom salt is made, occurs in huge quantities in several of our States. The drug is now practically a by-product of the manufacture of carbon dioxide for the soda-water trade.

From coal-tar, which, as we all know, is a by-product of the manufacture of illuminating gas and coke, is recovered benzol and carbolic acid, the former the source of phenacetin and acetanilid, and the latter of salicylic acid and aspirin, and itself used as an antiseptic. The fractionating of coal-tar has been carried out in this country for many years.

Turning now to the vegetable kingdom, which yields some of the most interesting and important drugs, we find that the world's supply of cinchona, or Peruvian bark, comes almost entirely from Java. The forests of South America, up to 1850, were the only producing areas; but the threatened destruction of the species producing the drug led to commercial propagation in India, Ceylon, and Java. Recently the reported discovery of new forests in South America has opened up the possibility of this country again becoming a factor in the industry.

Asiatic Turkey and Persia are the chief sources of medicinal opium. India and China were formerly large producers of the drug used in making smoking opium, but the traffic is now rigidly restricted in India and is supposed to be suppressed in China.

Coca leaves, from which cocain is extracted, come from Peru, where the plant has been cultivated since

before the dawn of history. Java will probably be an important source of supply in the future, since large plantations are being developed.

Licorice root, which in quantity is one of our largest drug imports, is obtained from Asia Minor, the Levant, and southern Europe. Only about 10 per cent. of this drug is used in the medicine industry, the rest being extracted and made into licorice paste, which is incorporated into chewing tobacco.

The leaf and the root of the belladonna plant, popularly called deadly nightshade (not the herb that grows in this country, commonly known as the deadly nightshade), are gathered in large quantities in southern Europe, and Austria especially, where the plant flourishes in the wild state. Belladonna itself is not used as a remedy for the eyes, as many persons suppose, but in the form of the extract (which is described in the next chapter), it enters into the composition of a great number of formulas of laxative pills and tablets and into belladonna plasters. Atropin, a chemical individual belonging to a group of complex organic substances known as alkaloids, is one of the constituents of belladonna, and this alkaloid is separated from the crude drug and yields the medicating agent used by the eye doctor. At the beginning of the war there was a shortage of belladonna, but rapid cultivation of the plant in the United States soon provided an adequate supply for our own use, and it was hoped that a permanent industry had been established. Since the cessation of hostilities the foreign supplies have again flooded the market, and at the present writing it is doubtful whether the belladonna-growers

in this country can meet the competition of the cheaper and inferior drug.

Digitalis, the purple fox-glove, an indispensable heart remedy, formerly came from southern and central Europe and the British Isles. Large quantities of the leaf were gathered in the Vosges, and importations of another species, not the purple fox-glove, were received from Spain. The war shut off the foreign supplies, and it has been reported that military operations virtually exterminated the plant in the Vosges district. Digitalis is indigenous in the States of Washington and Oregon, and desultory attempts have been made to establish its collection there, with moderate success. Cultivation of the leaf was aggressively prosecuted in Virginia and Minnesota, and, as the drug produced was superior to that obtained from the wild state, it jumped into immediate popularity, and with a certain class of trade is preferred even now to the cheaper drug that is again coming from Europe.

For many years the world's supply of camphor came from Japan, and that country is still a dominant factor in the trade; but artificial camphor is now an article of commerce. Within recent years, also, plantations of camphor-trees have been established in Florida. Camphor imported into the United States averages 3,000,000 pounds annually, a large part of which is used in the manufacture of celluloid and moving-picture films.

Aloes, the bitter juice that exudes from a prickly-leaved tropical shrub, is imported from several sources, the most common variety coming from Curaçao in the Dutch West Indies. It is also produced in

northwestern and southern Africa. This drug is often collected and dried in monkey-skins.

Referring briefly to some of the other staple crude botanical drugs, ergot is produced in Spain and Russia; gentian in the mountainous region of southern Europe; sarsaparilla and ipecac in southern tropical America; nux vomica in India and Cochin-China; rhubarb in China; and senna in Egypt and India.

Of our American botanicals, attention has been called to ginseng, one of our indigenous plants. Mandrake root, yielded by the May-apple, is gathered in enormous quantities in the Central and Eastern States, sufficient for our own consumption and for export. Cascara sagrada is collected on the Pacific slope, and is used extensively here as well as large quantities shipped abroad. Hydrastis, or golden-seal root, formerly abundant in the wild state in the Ohio Valley, but now approaching extinction, is cultivated on numerous small plantations in the United States, and the supplies gathered furnish the world's demand. Wild cherry bark for cough syrups and lozenges is collected on the Southern mountain slopes.

Suprarenal glands, the crude material for that valuable hemostatic adrenalin, now being universally employed in surgery and dental practice for the control of hemorrhage, are obtained from the large packing establishments engaged in the slaughtering of sheep. The same industry supplies the countless hog stomachs that yield the pepsin so necessary for indigestion, a characteristic ailment of our strenuous population. The fishing industry of Norway and Newfoundland is responsible for our supplies of cod-liver oil, which is

pressed out in tank-car quantities from the fish livers, stripped from the fish as they are tumbled out of the dories.

Thus it will be observed that the substances used by the medicine manufacturer and the doctor are drawn from all of the natural kingdoms, and that they come from all parts of the globe. Our own country produces many crude drugs and basic elements, and, because of its wide divergence of topography and climate, is admirably adapted to support the production of many botanical drugs, should conditions develop to prevent the importation of foreign supplies, as was the case with belladonna and other foreign species, not requiring the nurturing of a wholly tropical atmosphere. Furthermore, some of our younger and more aggressive and progressive dealers in crude drugs are establishing connections with the initial sources of the commodities in which they are interested, and are thereby no longer dependent on the collectors and exporters of the Middle European nations.

CHAPTER II

BEGINNINGS AND ACCOMPLISHMENTS OF THE MEDICINE INDUSTRY

In the state of society that existed in the periods prior to that which we recognize as possessing a consecutive history, when tribal customs prevailed, the sick in a community received aid from the headmen and the representatives of the religious orders. These leaders were simply those who possessed the superior intellect and physical characteristics, and who appreciated the credulity of the rank and file of their associates.

A knowledge of drugs and their uses was possessed by the ancient Chinese. Certain remedies, as exemplified by ginseng, were accorded almost superstitious reverence. The inroads made in the native supplies of this drug led to its practical extermination in Asia, and its cultivation was undertaken in Korea and Manchuria. Fortunately for the Chinese, the discovery of virgin stands of ginseng in the forests of the North American continent provided an unlimited supply of the drug for many years to come.

In prehistoric Peru coca was known as the divine plant of the Incas. The leaf of the shrub was in general use by the inhabitants, and no Inca was sent to his eternal rest without being provided with a bag of

the drug. These little parcels of coca, in a remarkable state of preservation, have been brought to light by exploring parties who have penetrated the ancient burial-places. The bags are often of beautiful design and show a high perfection of handiwork.

The ancient Greeks were familiar with the use of drugs before the days of Homer, who sings about Æsculapius, a Thessalian, deified as the god of healing. Temples were dedicated to their hero, and his disciples were called Æsculapiads. Greek medicine seems to have occupied a superior sphere of its own, and was not subordinate to religion, as was the case in ancient Egypt and India.

In the age of Pericles flourished the great teacher and physician Hippocrates (B. C. 460-377), known as the father of physic. The influence and teaching of this personage extended through the ensuing ages, and medical art as now practised dates from his time. The conquests of Alexander diffused the knowledge of Greek science. The development of Hippocratic medicine continued in Alexandria, and the study of anatomy was a feature of the Alexandrian school.

The development of medicine when Rome dominated the history of the world was due to the influence of Greek culture. The Romans did not possess an independent school of medicine. When medical science appeared it was an importation from Greece.

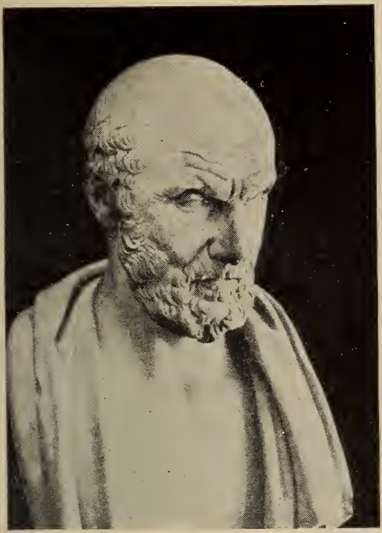
The most renowned of the Greek physicians at Rome was Asclepias, who was born B. C. 124. In A. D. 77-78 Dioscorides wrote a book on *materia medica*,[1] enumer-

[1] Materia medica is a term employed in a collective sense for all the various drugs and medicines used for the cure or mitigation of disease.

ating some four hundred plants and drugs. This work still remains the most important contribution on the remedies employed in ancient times. About a hundred years later Galen, the imperial physician at Rome, added some two hundred more plants. The three names just mentioned are not only outstanding lights in the development of medicine and pharmacy, but two of them are commemorated in *Dioscorea villosa,* the wild yam, the root of which is used in the treatment of dropsy, and *Asclepias tuberosa,* the butterfly-weed, or orange milk-weed, familiarly known as pleurisy-root; while Galen's name is responsible for the word *galenical,* which designates the pharmaceutical preparations of the natural vegetable drugs.

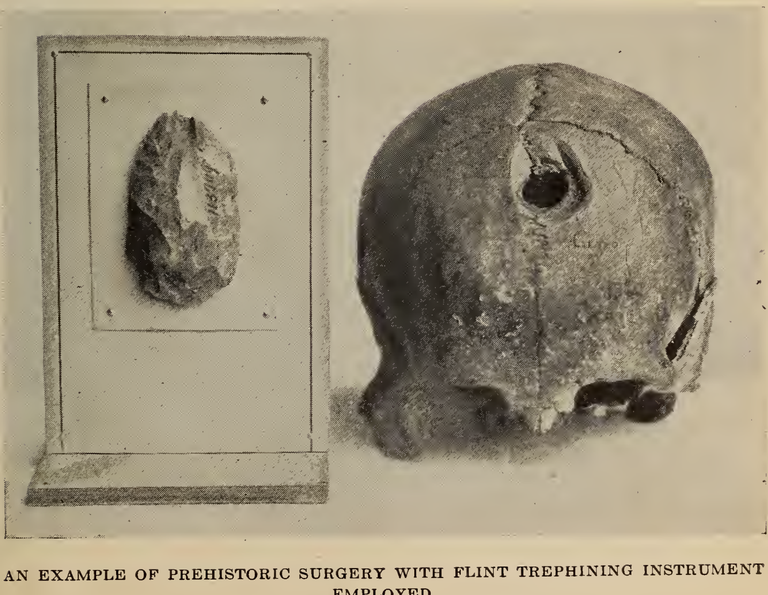
The hordes that overspread Europe following the decline of the Roman influence disseminated a knowledge of medicine and pharmacy that had been gradually accumulating from the earliest periods of the world's history. Among these people the dispensing of drugs had been practised by a special class of the priesthood. Egyptian inscriptions reveal how the physician-priests had sent their prescriptions to be filled by the priests of Isis. Papyrus records going back to B. C. 3300 contain references to the art of prescription-writing.

Many new drugs were now introduced into the materia medica. The knowledge acquired by the Romans from the Greeks, and augmented by the work of the philosophers who flourished when Rome was at the height of her glory, asserted its superior qualities over that of the Eastern conquerors. As it be-



HIPPOCRATES

GALEN



AN EXAMPLE OF PREHISTORIC SURGERY WITH FLINT TREPHINING INSTRUMENT EMPLOYED

A DRUG-PRODUCING ENTERPRISE AT THE BUSY SEASON

came absorbed and appreciated, and when peaceful conditions began to prevail, schools of pharmacy and medicine were established at Damascus and Bagdad, the chief seats of the Moslem power.

During this period we have the first records of the use of some of the remedies used in modern practice. In the sixth century Alexander of Tralles used colchicum for gout, iron for anemia, and rhubarb for dysentery and liver complaints. Diachylon or lead plaster had already been invented by Menecrates, A. D. 1, and was used by him for the same purposes as it is employed to-day. Under the Moslem influence the first apothecary shops were established and the first *pharmacopœia,* or set of drug standards, was produced. The separation of the practice of pharmacy was recognized in the eighth century and legalized in the eleventh.

Frederick II in 1233, by edict, divided the pharmacists into two classes: the *stationarii,* who sold the crude drugs; and the *confectionarii,* who dispensed the prescriptions of the medical men.

The supremacy of the Mohammedan influence over medicine and pharmacy continued through the Middle Ages, but during the monastic period pharmacy was largely under the control of the religious orders, particularly the Benedictines. The monks were forbidden to shed blood, so the practice of surgery was turned over to the barbers. The familiar barber's pole, with its spiral decoration, is a survival of those times when the barbers advertised their calling by a device representing the application of bandages.

Ancient and medieval surgery was barbarous in the

extreme. Ether and chloroform had not been discovered, and the use of local anesthetics was unknown. The operator utilized the crude instruments of the time, and his assistants held the head and extremities of the patient to prevent his struggles from interfering with the operation. Hemmorrhage was stopped by the application of a red-hot iron. This served a double purpose, though not appreciated at the time, for the heat destroyed the microörganisms that otherwise would have infected the wound and possibly set up blood-poisoning.

In prehistoric times the Incas performed a kind of crude surgery on those of their tribes who had received head injuries resulting in pressure on the brain. The skull was removed at the seat of the trouble by means of a knife or saw. The practice must have been wide-spread, judging from discoveries made during the excavation in the ancient Peruvian cities. In many cases the operations were apparently successful and the patient recovered, because, though the site of the cut is plainly visible, a new growth of bone has completely covered the opening of the cavity.

In England the separation of pharmacy from medicine did not occur as early as it did on the Continent. The first record of an apothecary's shop in London is in 1345.

About the time of the revival of learning, the discovery of America added a new influence in the progress of medicine and pharmacy. Many new drugs were carried to Europe by the explorers, and introduced into the materia medica, one of the most note-

worthy being cinchona, or Peruvian bark, which was first introduced into Spain in 1640.

Tincture of opium was prepared by Paracelsus (1493-1541), a German chemist, who called it laudanum, by which name it is still known.

The crude-drug dealers in those days were known as the *grossarii,* or sellers in gross, the term being subsequently modified to grocer. The apothecaries and physicians purchased their supplies from the grocers. In time the business of the grocers became specialized, those dealing in the vegetable and simple drugs being known as druggists, and those selling preparations made from minerals and requiring the aid of a furnace for their reduction being called *chymists,* later changed to chemists. The apothecaries were the real pharmacists of those days, and dispensed the medicines prescribed by the doctors. After 1720 the druggists and chemists entered into the field of practising pharmacy, thereby competing with the apothecaries.

Throughout the eighteenth century the science of chemistry made notable progress, and by the middle of the nineteenth it was firmly established on its present basis. The names of some of the most notable exponents appeared during this period. Cavendish, Black, Scheele, and Priestley fought out their theories of the nature of chemical compounds, and in the course of their researches many new substances and elements were discovered. Lavoisier laid the foundations for modern quantitative analysis by his brilliant work in Paris. Dalton elucidated the theory of the atomic weights of the elements, and Berzelius worked out the

equivalents of combining ratios of the elements, thus enabling the chemist to work out the reactions that occur when chemical substances unite, and to estimate in advance the quantities of the elements or compounds that are required to produce a new body.

Many of the discoveries of the indefatigable workers of this fruitful period had an important bearing on the progress of medicine. Boric acid was first prepared and used by Homberg in 1702. Ammonia gas was collected by Priestley in 1774. In 1804 Sertürner, a German apothecary, separated morphin in the pure condition, but did not fully describe it until 1817. Seguin discovered the same body in 1804, but did not appreciate its nature or importance. Ether was used in 1805 to relieve pulmonary distress, but it was not until 1842, in Athens, Georgia, that it was first used as an anesthetic for surgical operations. Pelletier and Caventou isolated strychnin in 1818, and two years later discovered quinin. In 1812 Courtois, a soda manufacturer in Paris, while attempting to remove with acid a deposit that occurred on his copper kettles, was astonished at the evolution of purple vapors, which proved to be iodine. Bromine was discovered in 1826 by Balard of Montpellier, France. In 1831 chloroform was made by Samuel Guthrie of Sackett's Harbor, New York, and independently in the same year by Soubeiran in France and Liebig in Germany. Cocain was added to the growing list of medicinal agents in 1855 as the result of the researches of Gardeke.

During the nineteenth century the attention of the civilized inhabitants of the world to peaceful occupa-

tions resulted in an enormous increase in population. The resources of the new Republic of the United States attracted settlers from the overcrowded cities and towns of Europe. Each census found our numbers increasing rapidly, both from this source and from the unrestricted breeding of our own people. Large families were the rule, not only in the rural districts, but in the cities.

It was only natural that with the expansion of industry and increase in population a change in the ways and means of dispensing medicines should occur. The old-fashioned apothecary with his mortar and pestle could not hope to remain the sole medium for compounding herbal mixtures and powders, and rolling pills for the new civilization. The importance of the chemical industry was becoming apparent, and the making of mineral salts and other organic chemicals was taken up as an individual industry. Drugstores increased in number, and by the middle of the century a few manufacturing pharmacists were established, soon demonstrating that they were permanent factors in the trade. From that time the development of the drug business tended toward the conditions that obtain at present.

The drug trade, as now organized, includes several independent factors, each one of which functions as a link in the chain of operations that finally places medicines within reach of the consumer. The chief factors include the crude-drug dealer, the manufacturer of medicinal chemicals, the manufacturing pharmacist who has a line of several hundred products, the proprietary or patent-medicine manufac-

turer, whose list, though usually small numerically, is often extensive in volume of sales, the physicians' supply house, the wholesale druggist, and the retail druggist.

To begin with, there is an important industry in the Carolinas engaged in collecting the many hundreds of our native botanical drugs, which for the most part can be obtained in paying quantities in the mountainous region of the Southern Appalachian System. The firms thus engaged receive their wares from the mountaineers, and their own collectors sort the drugs, bale them, and ship them to the crude-drug dealers in the large cities, and to the larger pharmaceutical manufacturers. In the Middle West, notably Indiana, the collection of mandrake root, slippery-elm bark, golden-seal, and wahoo is extensively handled. One dealer, Louis Sulzer, operating as Sulzer Brothers at Madison, Indiana, receives and distributes the world's largest quantities of mandrake and golden-seal. The firm was organized in 1884, and was an offshoot of an enterprise begun in 1854 by the father of the present owner, who was in the hide-and-wool business. At that time, as at present, most hide, fur, and wool dealers purchased ginseng, golden-seal, and mandrake.

By far the larger quantity of the drugs used in the compounding of medicines is placed in the hands of the manufacturers by the crude-drug merchants, of which there are several large firms located in New York, Philadelphia, Baltimore, and Chicago. New York is the center of the crude-drug trade of the United States. Not many of these houses make any

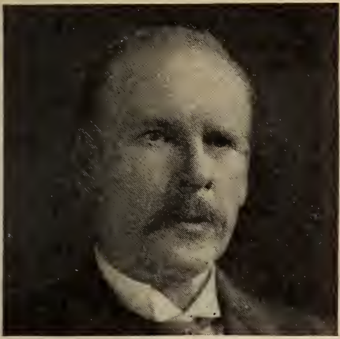
pretense of supervising the collection of the wares they handle. They receive their supplies from the firms engaged in the collecting business, and import foreign-grown drugs from the European cities, London, Amsterdam, Marseilles, and Hamburg, as well as from South America, Africa, and Far Eastern ports. Their chief business is to supply the manufacturing pharmacists with their crude material in so far as it consists of drugs of vegetable origin. They grind and powder roots, leaves, barks, and herbs to be put up in small packages for distribution through the wholesale drug dealers. Some of them have elaborately equipped plants for making bulk extracts of the vegetable drugs, with which they supply the smaller manufacturers of pills and tablets, and the miscellaneous trade which may require large quantities of some individual commodity, such as extract of licorice by the plug-tobacco makers, and extract of belladonna by the manufacturers of plasters. In this way their business merges with that of the larger pharmaceutical manufacturers, who, in addition to making the extracts they use in their pills and tablets, solicit trade in extracts wherever it happens to exist.

Paralleling the crude-drug industry, in its relation to the drug trade in general, is the manufacturing chemical business. The firms operating in this field supply the makers of medicine with their salts, such as potassium iodide, the bromides, chlorate of potash, tartar emetic, and all others of mineral origin; their pure organic principles, which are derived from crude botanical drugs such as morphin, cocain, quinin, caffein, strychnin, digitalin, and santonin; and their

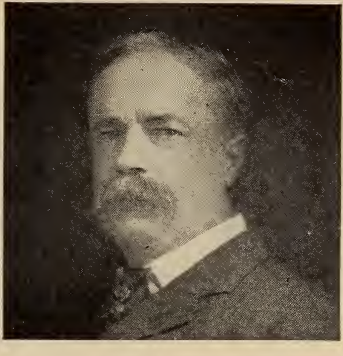
synthetic organic compounds, acetanilid, phenacetin, aspirin, chloral, etc. They also prepare ether and chloroform, which are distributed to the hospitals and smaller users through the wholesale drug trade.

Manufacturing chemists usually obtain their crude materials directly from the source, or from the distributing centers, just as do the crude-drug merchants. They go to China for their antimony; to Amsterdam for their cinchona, from which they make quinin; to London for their opium, from which they extract and purify morphin, and codein; and so on all over the world where the original source or chief distributing center exists. Their products go to other industries besides those engaged in preparing medicines. For instance, about 80 per cent. of the strychnin manufactured is consumed by the government and private interests in destroying predatory animals, coyotes, timber-wolves, mountain-lions, ground-squirrels, and pocket-gophers. Caffein, though employed to the extent of thousands of pounds in compounding headache mixtures, is consumed in many times greater quantities by the soft-drink trade.

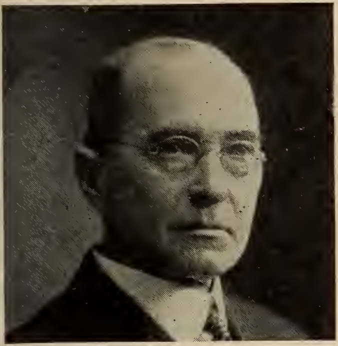
The expansion of the manufacturing chemical business in the past twenty years has been marvelous. Many new firms have appeared during this period, and some of them have become factors in the world's trade. Prior to 1900 the bulk of the business was handled by the Mallinckrodts in St. Louis; Powers and Weightman and the Rosengartens in Philadelphia; Pfizer, Merck, and the New York Quinine & Chemical Company in New York. Then the Dow Chemical Company established a foothold in the trade by its



H. H. Rusby

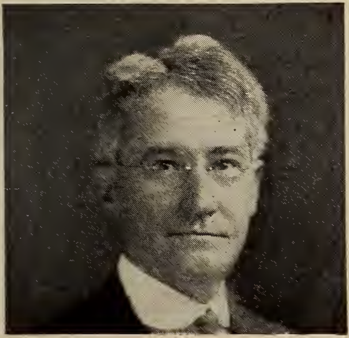


Joseph P. Remington



John Uri Lloyd

James H. Beal



C. H. La Wall

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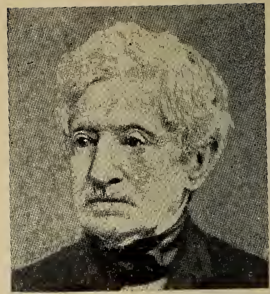
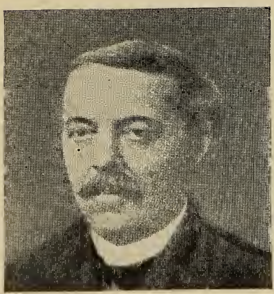
S. L. Hilton

A FEW OF THE SCIENTISTS AND EDUCATORS RESPONSIBLE FOR THE HIGH CHARACTER OF MODERN PHARMACY

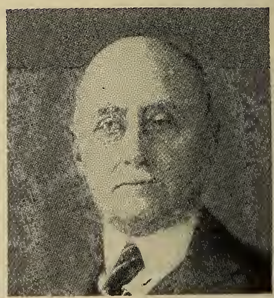
E. R. Squibb



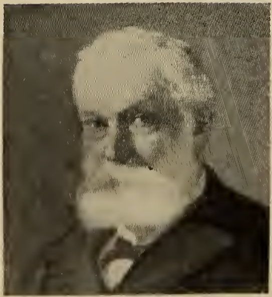
George Rosengarten



Eli Lilly



J. L. Hopkins



A. M. Todd

H. C. Parke

FOUNDERS OF THE DRUG AND MEDICINE MAKING BUSINESS
AS IT EXISTS TODAY

development of the bromine-containing brines of Michigan, and it now practically controls the trade in bromides. The Monsanto Chemical Company started in St. Louis, and is now an important factor in the production of saccharin, phenolphthalein, phenacetin, and caffein. The Schaefer Alkaloid Works of New Jersey have specialized in the production of caffein, of which they are probably the largest producers in the world, and also make artificial vanillin and the salts of lithium.

The development of the house of Powers, Weightman, Rosengarten, of Philadelphia, is typical of the rise of the manufacturing chemical industry in this country. In 1818 an Englishman of the name of John Farr, in partnership with Abraham Kunzi, a Swiss, began making chemicals in Philadelphia. They took up the manufacture of quinin salts in 1823, soon after Pelletier and Caventou made known the results of their experiments. Kunzi retired in 1838, and Farr associated with himself Thomas H. Powers and William Weightman. Farr died in 1841, and from that time until the merger with the Rosengartens the firm was known as Powers & Weightman.

The manufacturing business of Rosengarten & Sons was established in 1822. The original partners were Seitler and Zeitler, but George D. Rosengarten joined the firm in 1823, and from that time until 1879, when he retired, was the guiding spirit of the enterprise. In 1853 the firm name became Rosengarten & Sons, and was incorporated as such in 1901. In 1824 they were manufacturing quinin salts, ether, spirits of niter, aqua ammonia, acetic ether, and Hoffman's

anodyne. Morphin salts were added to the list in 1832, and in the next three or four years the firm embarked upon the manufacture of such important medicinal chemicals as calomel, strychnin, veratrin, codein, bismuth salts, and the iodides.

By the end of the nineteenth century both firms were manufacturing full lines of all of the high-grade chemicals used by the druggists in their prescription trade, and by the manufacturing pharmacists for their many thousands of formulas that required the use of drugs of this character. Their operations extended all over the world, and their fame has had much to do with the establishment of Philadelphia as a chemical-manufacturing center.

In 1905 the firms united under the name of Powers-Weightman-Rosengarten Company, and since that time the active management of the business has been carried on by the son of George D. Rosengarten and four grandsons.

The drug collectors, the crude-drug dealers, and the manufacturing chemists supply directly to the makers of medicines the ingredients that go to make up the numerous types of medicines that are dispensed or prescribed and consumed by the public. The makers of medicines include the large manufacturing pharmaceutical houses, the proprietary or patent-medicine makers, the wholesale druggists, and the retail druggists. The volume of manufacturing done by the latter two interests is considerable, but actually represents but a small proportion of the total output of medicines. In theory the wholesale druggists act as distributors for placing the goods of the manufac-

turing chemists, pharmaceutical houses, and proprietary makers in the hands of the retailers, but most of the wholesalers make complete lines of the standard pharmaceuticals. Some of them make their own chemicals and engage extensively in importing, receiving, and distributing crude botanical drugs. Hence there is no clear line of demarcation between the manufacturer and the wholesaler.

The manufacturing pharmaceutical houses prepare fluid and solid extracts, elixirs, syrups, emulsions, pills, tablets, lozenges, effervescent salts, plasters, suppositories, medicinal wines, vaccines, serums, and various special preparations, representing in the aggregate thousands of different formulas and combinations. Their output is sold all over this country and many of them have branch laboratories in foreign lands.

This industry began to make itself known in 1850. Prior to this time all medicines were compounded by the retail druggists, and nearly all of the old established firms now in existence had their inception in the corner drug-store. By the middle of the century William S. Merrell was busily engaged in turning out medicines in Cincinnati, his concern being the outgrowth of a pharmacy that he started in 1828. He was a skilled chemist, constantly delving into the mysteries of his chosen profession, and was the first to prepare and offer for sale podophyllin, the active resinous constituent of the mandrake root. In Lebanon, New York, Henry A. Tilden, brother of Samuel J. Tilden, had founded the house of Tilden & Company, and was turning out the first fluid extracts ever offered

the trade and profession outside of the drug-store. Henry Thayer in Cambridge, Massachusetts, founded the house that still bears his name.

During the ensuing twenty-five years manufacturing pharmacy made great strides. The firms above mentioned grew and prospered. New interests entered the field. Names that stand for what we know to be the highest ideals in the profession appeared during this epoch. From Kentucky came John Uri Lloyd and founded in Cincinnati the house of Lloyd Brothers.

To Detroit came Frederick Stearns from Buffalo, and in 1855 began the upbuilding of a successful business that never ceased to expand. He operated both a drug-store and a manufacturing plant, and the first telephone installed in Detroit was a private line connecting those two establishments.

In Baltimore in the fifties the brothers Louis and Charles E. Dohme were clerks in the retail store of Alpheus E. Sharp. In 1860 the partnership of Sharp & Dohme was formed. In 1862 Dr. Samuel P. Duffield, a druggist in Detroit, began to develop a small manufacturing business, later associating with him Hervey C. Parke and George S. Davis, and in 1867 the firm of Parke, Davis & Company was fairly launched.

During this period comes also Dr. E. R. Squibb, of Brooklyn, who won the lasting confidence of the medical profession with his ether, chloroform, fluid extract of ergot, and tincture of digitalis. He became famous during the Civil War as medical purveyor for the army. John Wyeth, renowned for his lithia tablets, was developing a rapidly expanding business in

Philadelphia. William R. Warner was exploiting a line of beautiful sugar-coated pills.

In 1876 Colonel Eli Lilly, after several years of preliminary experience and associations, launched his own establishment in Indianapolis, and to-day the red Lilly insignia can be found on packages of pharmaceuticals all over the world. In 1887 Henry K. Mulford, then a drug clerk, bought a controlling interest in the "Old Simes Drug Store," a Philadelphia landmark that dated back to 1815. The house of Mulford is to-day one of the largest firms in the world engaged in the manufacture of medicines. It has specialized in biological products, serums, and vaccines. The animals utilized for the production of these indispensable remedial agents have for years been maintained under ideal conditions on a beautiful farm at Glenolden, a suburb of Philadelphia. From the very beginning of its history the company has endeavored to develop the professional ideal so long taught by the colleges of pharmacy, and in the developing of this ideal the house has attained its success. In 1886 Dr. Upjohn had successfully introduced his friable pills. In 1889 Edgar L. Patch began manufacturing operations in a converted shoe shop in Stoneham, Massachusetts.

The limits of this chapter will not permit of more than passing mention of all these great names. There are many others who deserve recognition, and we should not omit the Schieffelins; McKesson and Robbins of New York; and the Burrough Brothers of Baltimore.

While prior to 1850 the preparation of all kinds of

medicines was entirely a function of the druggist, to-day his work of this character is limited principally to the compounding of prescriptions and the manufacture of some favorite specialty or the simple formulas of the National Formulary and Pharmacopœia. The evolution of the manufacturing pharmaceutical houses was inevitable. The demand for properly prepared medicines has increased enormously, both on account of the rapid growth of the population, and the progress in the knowledge of treatment of disease. Hand in hand with the increased consumption of medicines has grown the dependence of the doctor on reliable and standard products. Large-scale production under the surveillance of a corps of expert chemists, botanists, pharmacists, and executives is the only means by which the present demand can be satisfied.

The modern medicine factory is equipped with such an array of special apparatus and machinery that the old-time alchemist, could he be resurrected to-day, would be confirmed in his belief in the transmutation of elements. Unsightly masses of paste are quickly converted into spherical or oval pills of uniform shape and size by special machines capable of turning out hundreds of thousands each working day. Brown pills, after being transferred to immense rotating drums, reappear in due course with a smooth coating of sugar and a brilliant color of pink or blue or gold. White granular mixtures, resembling irregular particles of sugar, are fed into automatic rotating stamping-machines, which deliver thousands of beautifully formed compressed tablets of any size or shape desired. Enormous percolators, holding hundreds of

pounds of pulverized roots or bark or leaves, deliver a continuous stream of fluid extracts, representing the valuable constituents of such potent remedies as nux vomica, digitalis, belladonna, ergot, or opium. Steam-jacketed vacuum stills, with capacities ranging up to five hundred gallons, concentrate the extracts at low temperatures, whereby the delicate chemical constituents on which the value of the remedy depends are uninjured. The thick molasses-like concentrations flowing from the bottoms of the big stills after all the solvent has been driven off, are later worked up into the pills and tablets and other mixtures of varied character.

Automatic counting and filling-machines transfer pills and tablets to an endless chain of bottles and boxes. Special bottling apparatus, delivering to a nicety an ounce, a pint, a gallon, or whatever the quantity required, transfers without loss the liquid remedies to an endless chain of bottles, which are later corked, sorted, and labeled by skilled operators. Control laboratories, manned by expert chemists, botanists and physiologists, pass on the quality of the crude materials employed in the manufacturing operations, and standardize and place the final approval on the finished medicines. In the factories where serums and vaccines are prepared the rooms in which the animals are treated are kept scrupulously clean with antiseptics. The attendants are carefully clothed, the apparatus sterilized, and even the air entering the chambers is filtered through absorbent cotton to avoid any possible contamination from undesirable germs.

This, in brief, visualizes the medicine plant of to-

day. A century ago nothing like this existed. A few glass and metal percolators for extraction purposes, mortars and pestles for mixing and compounding, ordinary pots and kettles for heating, a still heated directly on the fire, and a metal worm without vacuum attachment constituted the principal equipment of the dispensing pharmacist. Pills were rolled by hand and left uncoated. Compressed tablets were unknown. Uniformity in the character of the medicines was a chance, and standardization was unheard of.

Before passing on to the discussion of another important element in the field of medicine manufacturing, reference must be made to the phenomenal growth of an idea that is strictly a twentieth-century proposition. Less than twenty years ago the United Drug Company began to make a complete line of medicines, with the object of establishing direct connection with the consumer through the medium of the retail druggist. The Rexall line was thus launched, and to-day the Liggett stores and others handling preparations bearing the familiar label with the device ℞ (which was originally an invocation to Jupiter of the ancient medical men) are known throughout the length and breadth of this great country. The factory of the United Drug Company is one of the largest and best equipped plants of its kind in the world. The company also has its own units engaged in making the specialties sold in the Liggett stores, which are gradually acquiring the character of universal bazaars.

While the firms engaged in making the numerous medicines prescribed and dispensed by the physicians represent an enormous investment of capital, and

their annual business amounts to a turn-over of many millions of dollars, the makers of the popular remedies known as proprietary or patent medicines do a much greater business, both in volume and from a monetary point of view, and have a much larger investment of capital. The origin of this industry differs in some respects from the inception of the manufacturing pharmaceutical houses. Most of the firms engaged in producing patent medicines are concerned each with one or two specialties. These preparations are usually based on some mixture that at one time enjoyed repute among the aboriginal inhabitants of the country, or a favorite household remedy, or the prescription of some physician that has shown marked virtues, or a special product evolved by a dispensing pharmacist for which there developed such an extensive call that the proprietor finally devoted his entire attention to its preparation.

To cite a few cases, it is interesting to relate that as far back as 1825 the formula of SSS, a popular remedy for rheumatism and blood diseases, was being prepared and used locally by the Indians and pioneers settled in Georgia. Personal recommendation increased the demand for the preparation, which is a liquid made from extracts of certain potent drugs indigenous to the South, and in Atlanta in 1870 its manufacture was taken up on a factory basis. From a plant operating at that time with one small iron percolator for extracting the drugs, the business has increased until to-day a large manufacturing establishment, equipped with special steam-jacketed extractors working day and night, mixing-tanks and aging tanks

possessing a capacity of more than half a million gallons, and automatic bottling and labeling machinery of the latest design, is required to handle the yearly output.

Somewhere about the year 1836, a young man born in New Jersey found his way to Philadelphia, looking for work. He was suffering from a disease of the lungs. He tried every doctor and every remedy he could reach, without relief. Giving up hope of getting well, he returned home. Soon afterward he was given a formula for a home-made syrup by an old lady who had used it in her family. The principal ingredients of this formula are said to have been obtained from the medicine-men of the Shawano tribe of Indians. Making up a quantity of this syrup, the young man started taking it, and soon began to improve. Recovery was slow, but he gained little by little, and in less than a year was well and healthy. Naturally, the incident of his recovery caused widespread inquiries to come to him from the surrounding country, and he was besieged with requests for the cough syrup. For a while he prepared it for his neighbors without charge, but the demand for it grew in excess of his means. He then began making a nominal charge for each bottle to cover the cost of ingredients. At this he could not manufacture it in his own home fast enough to keep up with the demand. He thereupon decided to move to Philadelphia and make a business of manufacturing and selling the syrup. Hence the origin of Schenck's Syrup. Mr. Schenck then began the study of medicine, and, following the knowledge obtained, he began experimenting with nature's

herbs and roots, with the result that Schenck's Mandrake Pills and Schenck's Tonic were brought into existence. The original Dr. Schenck lived forty years after he was given up as incurable. He was succeeded by his son Dr. J. H. Schenck, and the grandson of the original Dr. Schenck is now the owner of the business.

In 1873 there lived in Lynn, Massachusetts, a typical old-time New England housewife, active in the affairs of the town, and the friend and confidante of her neighbors to whom they turned in time of distress and sickness. Her name was Lydia E. Pinkham. At the time this narrative opens she was facing the world with an invalid and impoverished husband and a large family. In her neighborhood ministrations she had often helped the afflicted with the receipt for a botanic remedy for diseases of women, which she had known to be effective in the practice of a great physician. It was proposed that she prepare the remedy for sale. The necessities of her family demanded that she do something, and thus originated the famous Vegetable Compound, so well known to women everywhere.

At first she procured the herbs, steeped them, and prepared the remedy in the true old-time fashion on the kitchen stove. At the time of her death in 1883 the business was well established, and to-day the Pinkham Medicine Company possesses one of the finest equipped plants in the world. From the time the drugs are transferred to the percolators until the finished medicine is bottled, the operation of manufacture is entirely automatic. Every precaution is taken to prevent contamination, the product is subjected to

thorough pasteurization, and is even bottled in a special room under aseptic conditions.

In 1888 Captain Isaac Emerson, a druggist of Baltimore, worked out the formula of a headache remedy, which he sold over the counter of his store. The demand for it grew so rapidly that a year later he gave up his retail business and began to manufacture it exclusively. Thus was born Bromo Seltzer, to-day the most popular effervescent salt on the market. The manufacturing plant in 1889 occupied a small room above a restaurant, but the business soon outgrew this location, and finally, after several changes, was installed in the specially designed and equipped Tower building, which is now an outstanding mark on the Baltimore sky-line. Here is installed everything that modern ingenuity can devise for turning out a perfect granular effervescent salt. The air of the mixing- and filling-rooms is dehumidified so that, regardless of weather conditions there is no danger from absorption of atmospheric moisture. The slightest excess of moisture in the preparation would be likely to set up a chemical reaction after the product is bottled, and the pressure exerted by the liberated carbonic-acid gas would burst the container, causing inconvenience to the purchaser and embarrassment to the company.

The purest ingredients only are employed in compounding Bromo Seltzer. The company supervises the manufacture of its principal chemicals, such as the bromides, caffein, acetanilid, and citric acid. In 1908 it began to manufacture its own bottles, and is to-day the largest manufacturer of blue-glass bottles

in the country. During the war, when practically every large manufacturer of medicines was having trouble in securing bottles and raw materials, the Emerson Drug Company experienced no inconvenience of that nature.

In the town of Erie, Pennsylvania, in the middle of the nineteenth century, Dr. J. S. Carter was engaged in the practice of medicine. He was also the proprietor of a drug-store. Like nearly all general practitioners, he had his favorite prescriptions which he had found effective, and which he prescribed when occasion required. Many of his patients suffered from the results of imprudent eating and the accompanying disarrangement of the working of the alimentary canal. Constipation was the coming national ailment. For these sufferers he prescribed a simple formula composed of efficacious vegetable drugs, and directed that it should be put up in the form of pills. The patients left the door of the doctor's office and went into the door of the pharmacy around the corner, where the clerk in charge put up the prescriptions in the old-fashioned way, rolling the pills by hand. Gradually the fame of Dr. Carter's remedy became widespread. People who had obtained relief recommended the treatment to their friends, who came to the drug-store and asked for some of Dr. Carter's little liver pills. Hence the origin of the formula of this famous remedy, and the name by which it is still known, which was given it by its users. To-day many millions of these pills are sold annually, and they are known all over the world in the little vial with the familiar label and large letters.

Incidents of this character could be cited without limit, but these are typical of the origin and development of all of the successful legitimate proprietary medicine houses. Dr. Pierce's Golden Medical Discovery and Favorite Prescription were placed on the market in the late sixties. They were the fruits of the experience of Dr. R. V. Pierce, who practised medicine in Hydetown and Titusville, Pennsylvania, prior to 1866, when he settled in Buffalo. Hood's Sarsaparilla was suggested to Mr. Hood by a prescription of a Dr. Oliver, a famous Boston physician.

We must refer, in passing, to a unique branch of the medicine industry which had its origin in Winona, Minnesota. It is known as the "wagon trade," and is conducted by a dozen or more firms scattered through the central United States. They make medicines, perfumes, toilet articles, etc., and distribute them through the rural districts by personal contact with the purchasers. The system of distribution recalls the old-fashioned tin peddler whose red wagon was a familiar sight along the roads of New England thirty years ago. These firms bring the drug-store to the home of the customer, and the housewife is able to replenish her medicine-chest with a sufficient quantity of her necessary and favorite remedies to take care of her requirements until the wagon again makes its periodical visit.

The physicians' supply houses, so-called, are actually manufacturing pharmaceutical plants. Their line is somewhat smaller than that of such firms as Parke, Davis & Company, or Mulford, and the volume of their business is but a small fraction of that done by the big

firms. These institutions have about the same relation to the dispensing physician that the wholesale druggist does to the dispensing pharmacist, with the marked difference that their manufacturing departments are more of a feature.

As we have already indicated, the bulk of the medicines and drugs that are put in shape for the use of the retail druggist by the crude-drug dealer, manufacturing chemist, manufacturing pharmacist, and patent-medicine maker, are distributed through the wholesale druggist. Representatives of this branch of the trade are found in the larger cities. Some of them put out complete lines of pharmaceuticals under their own labels too, but their chief concern is to see that the corner drug-store, the hospital, and the scientific institution are equipped with the miscellaneous drugs and chemicals that they require in the daily conduct of their business.

Thus it will be seen that there is a vast and intricate system concerned with the collection, preparation, and distribution of our drugs and medicines. Each factor has its own part to play, and the development of each has resulted from the operation of the subtle economic conditions that have accompanied the progress of our country from the inception of the infant Republic to the commanding and superior position that it now maintains.

It is fitting that a tribute should be paid to the great educators and scientists who have inspired those who have been instrumental in placing on a substantial basis the great industries we have noted. Their researches and discoveries have changed the science of

medicine and pharmacy from one of empiricism to one based on actualities. Great men are these and known to all who have been associated with pharmacy during the past half century. The late Joseph P. Remington, for many years dean of the Philadelphia College of Pharmacy, and Chairman of the Revision Committee of the United States Pharmacopœia, author and teacher, comes first to the thoughts of all because of the inspiring influence he wielded for so many years. Lucius E. Sayre, originally from Philadelphia, where he at one time conducted a drug-store in partnership with Remington; Henry H. Rusby, the famous botanist and explorer, who has added many useful drugs to the materia medica; John Uri Lloyd; Harvey W. Wiley; Charles Caspari, Jr.; Edward R. Squibb; Albert B. Prescott; Edward Parrish; William Proctor; and John Maisch—all have left their impressions on the progress of science. Martin I. Wilbert, in his picturesque way, for years maintained a happy liaison between the scientists of the pharmaceutical and medical professions. Frederick J. Wulling, venerable exponent of pure pharmacy in the Northwest; Eugene G. Eberle; Joseph W. England; Henry M. Whelpley; Charles E. Caspari; Samuel L. Hilton, alert and aggressive in all the great movements of the period affecting the science and industry; Edward Kremers, leading authority on the essential oils; Warner W. Stockberger, economic botanist and exponent of drug cultivation; Charles H. LaWall, scientist and teacher, ably and aggressively filling the place of Remington with his youthful exuberance—all are to-day the leaders in the profession, to whom the in-

dustry of medicine-making looks for its help and inspiration. And finally do we all pay homage to James Hartley Beal, with the realization that as long as he survives a great leader watches over the destinies of the science, since it is his wide experience and profound knowledge of the influences affecting pure and applied pharmacy that have often shown the light when doubt or hesitation existed.

CHAPTER III

HOW MEDICINES ARE MADE

The maker of medicines, if he is one of the group putting out a full line of products, exclusive of patent medicines, sold by the retail druggist and prescribed by the physician, manufactures fluid and solid extracts, elixirs, syrups, emulsions, liniments, antiseptic washes, special liquid mixtures, pills, tablets, lozenges, troches, hard and soft filled capsules, granular salts, plasters, ointments, pastes, suppositories, and sometimes serums and vaccines. These are the principal forms in which medicines find their way into the trade. The formulas are legion. The methods of preparation are virtually the same in every establishment. Some firms have better equipment than others, and some are possessed of superior talent, which enables them to turn out better and more stable preparations than their competitors. But at the present time there is no secrecy about the general methods employed, and the manufacturing pharmacy on a large scale is practically an open book.

An insight into the details of some of the processes will be interesting. First we will describe the manufacture of drug extracts, for these are the simplest forms of galenical preparations, and they are used to a considerable extent in the preparation of other medicines.

A fluid extract is a preparation made by removing from a vegetable drug its essential or medicinally active constituents by means of a liquid. The valuable components of the drug dissolve in the liquid and are thereby separated from the insoluble and useless portions. The dissolving liquid, called the solvent, is usually alcohol. Fluid extracts should not be confused with flavoring extracts, which consist of some volatile oil or flavoring principle dissolved in alcohol. Flavoring extracts are products of the food industry, and are made by simply adding the proper proportion of the pure oil or flavoring compound to the pure alcohol. (Vanilla extract differs in its mode of preparation and conforms more nearly to a true fluid extract.)

The list of fluid extracts includes those from all the vegetable drugs that are worth while. Ordinarily they are adjusted so that a pint of the finished extract represents one pound of the crude material used. A tincture is similiar in character, but is usually only one tenth as strong, and may be obtained in the same way or by diluting the fluid extract.

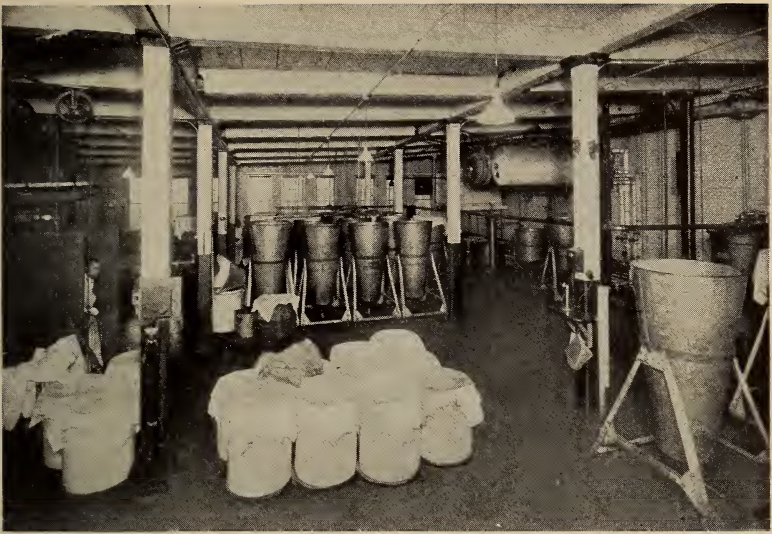
In making a fluid extract of belladonna leaves, as an example, the crude drug is carefully weighed and then passed through a grinding-mill in which it is reduced to a coarse powder. If pulverized too finely it will clog the percolator and prevent a steady flow of the liquid. The ground drug is then transferred to a macerating-machine shaped like a drum and fitted with a revolving device on the order of a mangle. It is first moistened with alcohol of the strength used for extraction, 75 per cent. in the case of belladonna, and then the machine is set in motion.

The quantity of solvent (designated also as *menstruum* in the pharmaceutical world) added is sufficient to dampen the drug but not to render it mushy. After a uniform mixture is obtained the moist material is introduced into the percolators, which vary in capacity from a few gallons up to large volumes. The percolating-room of a large manufacturing house contains dozens of units of all sizes. They are shaped like inverted truncated cones, open at the top and closed at the bottom. The flow of liquid is controlled by a spigot or valve opening out of the bottom.

The packing of a percolator is an art in itself. The drug must be evenly distributed, and if a large quantity is being introduced layers of excelsior or some similiar elastic material must be added to relieve the pressure and prevent clogging. The percolator is never completely filled, as it is necessary to leave a space above the surface of the drug mass for the liquid to stand.

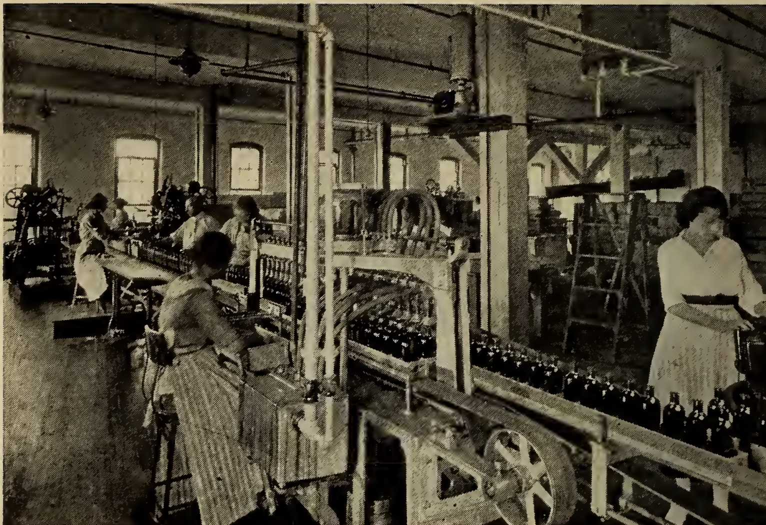
The solvent is allowed to flow onto the mass, and when it has penetrated to the bottom and begins to drop, the valve is closed, the percolator is covered, and the drug allowed to soak for several days. By this means the alcohol gradually works its way into the cells of the leaf and dissolves the valuable medicinal constituents.

At the end of the soaking period, the valve at the bottom of the percolator is opened, and a slow steady stream of liquid is allowed to run out. More alcohol is added from time to time in order to keep a uniform head of liquid above the surface of the drug mass, and this is kept up until all of the medicinal constituents



PERCOLATORS USED FOR REMOVING THE VALUABLE CONSTITUENTS OF CRUDE DRUGS

A TYPE OF JACKETED PERCOLATOR FOR HOT EXTRACTIONS



BOTTLING MEDICINE AUTOMATICALLY

MACHINE FOR MAKING CAPSULES

have been taken out of the leaf. When the liquid first begins to flow, it is thick and very dark; and when a quantity of about the volume of the percolator has passed through, it is set aside and the balance of the liquid collected separately. The liquid coming from the outlet of the percolator is called the *percolate*. As the process continues, the percolate gets lighter and lighter in color until a point is reached when there is nothing more of value left, and the drug mass is said to be exhausted. The weaker portions of the percolate are then deprived of the alcohol by means of distillation in a vacuum apparatus, and the thick, syrup-like residue left in the still is dissolved in the first fraction of the percolate that has been set aside, and the solution adjusted with the proper quantity of solvent, so that it will represent in pints the number of pounds of drug used.

This is the general procedure that is followed in manufacturing the fluid extracts of all the valuable botanical drugs. In some cases the solvent will vary, and in making the fluid extract of cascara sagrada, water is the menstruum employed.

Not all fluid extracts are made strictly on the basis of a pint to a pound. Those containing medicinally valuable ingredients, capable of being estimated by chemical or physiological means, are adjusted to proper strength after a laboratory test. This is called standardization. The standards that have been adopted for the potent fluid extracts have been determined from studying the results of thousands of chemical or physiological examinations made on different drugs. These tests are known technically as assays.

The importance of laboratory control can be realized when it is stated that different lots of the valuable drug belladonna may show a variation in their medicinally active constituents running from 0.2 per cent. to more than 1 per cent. The manufacturer who is able to obtain the drug of high potency has a decided advantage over the man who has to be content with the inferior drug. The former can, with perhaps one quarter the amount of material, a correspondingly less consumption of percolating menstruum, and in a shorter period of time, obtain the same quantity of fluid extract as the latter who is obliged to grind more weight of drug, fill up more percolator space, consume more solvent, and with greater labor cost.

Solid extracts are prepared in the same way as are fluid extracts, but the solvent is entirely removed by means of a vacuum still. They are dark, sticky masses consisting of the potent constituents of the drug with most of the coloring matter, resins, gums, and other substances which dissolve in the menstruum. They are standardized either chemically or physiologically, just as are the fluid extracts. Enormous quantities are produced by the manufacturing pharmaceutical houses, and the bulk of them are used as components of other forms of galenical preparations. They are mixed with other ingredients and compounded into pill masses and tablet granulations, rolled out into plasters, worked into capsules, and combined in various ways with many other special preparations.

One of the most interesting operations to the non-scientist in a modern pharmaceutical factory is pill-

rolling. A pill formula may contain from one to a dozen essential medicinal ingredients, and these are first assembled in the mass room, where they are mixed with the glucose, sugar, starch, licorice extract or something of the sort to give a body or substance to the pill, and then the mixture is transferred to a mass-machine. Heavy rollers of iron or wood, operated by power thoroughly blend the various components, and the process is continued until the mass is of proper consistency, which is about that of putty.

The mass then goes into a wonderful automatic machine, which first shapes it into long cylinders, then cuts them into segments, which in turn are rolled into pipes of proper diameter between broad bands of rubber, the opposing surfaces of which move in opposite directions. The pipes fall on fluted plates, which cut them into little cylinders, and then by oscillating bands they are rolled into spheres or ovals, and finally delivered from a spout at the end of the machine. By proper adjustment of plates and bands, large or small pills are produced, and the entire operation is automatic after the pill mass is thrust into the machine. The daily capacity of one of these units may run as high as 800,000 pills.

Before being coated the pills have to be dried or cured. This is one of the most important stages in pill production, because a pill that is improperly cured may become so hard that it will not dissolve in the internal liquids of the human anatomy and pass unaltered through the alimentary canal. They are placed on trays containing clean, dry flour with which they are completely covered. The trays are placed

in compartments through which warm air is caused to circulate, maintaining a nearly uniform temperature. The effect is gradually to abstract the superfluous moisture, leaving the shape and physical structure of the pill unaltered, and the mass in such condition that the digestive fluids can permeate and dissolve the pill.

The sugar-coating of pills is done in large revolving pans, set at an angle and operated by power. The pills, when properly cured, are transferred to these pans, and warm syrup is poured over them. The syrup contains the coloring matter, which may be red, blue, yellow, pink, or gold. As the pills roll over one another and down the ascending side of the pan, they become coated with the syrup. This dries, forming a hard sugary coating of handsome appearance. Directly above each pan is the outlet of a supply of dry air, which is allowed to play upon the pills at the discretion of the operator. The process requires considerable skill and the exercise of good judgment. The coating must be evenly distributed and as thin as possible, so as not to increase unduly the size of the finished product; yet there must be sufficient sugar to protect the mass from deterioration and effectually to mask the taste of disagreeable drugs.

When the process of coating is completed, the pills are placed in a drum the sides of which are lined with canvas that has been treated with wax. When the drum revolves in the same way as do the coating cylinders, the pills take on a glossy finish, which adds to their durability and attractiveness.

Pills are coated with gelatin by an entirely different

procedure. At one time there was a secret process employed by one or two firms. It was operated by making a combination of gelatin and gum arabic that was dried and powdered. This powder was applied to the pills in a revolving pan of the same style used in sugar-coating. The pills were placed in single layers in trays, which were introduced into a steam-box and a jet of steam was brought in contact with the upper surface of the pills, resulting in a smooth glaze. After drying, the pills were stirred and re-arranged so that another surface was uppermost, again exposed to the steam, and the operation continued until all the pills were uniformly glazed. Those manufacturers who were unfamiliar with this secret were obliged to employ the tedious process of impaling the pills on pins and dipping them by hand into the hot liquefied gelatin.

Both of these methods have been superseded by the vacuum process. The coating-machines are of peculiar design. The uncoated pills are poured out on the wooden shelf in front of the operator. A hollow metal bar, as long as the machine is wide, with hundreds of perforations in the upper surface, and an opening at one end to which may be attached a flexible tube connected with an air exhaust, is inverted over the mass of pills. The vacuum is applied, and the little pills jump to the openings, where they are held in place by the air pressure against the vacuum within the bar. The pills are then lowered into a bath of hot gelatin solution until a little more than half the surface of each has been immersed. The bar is then turned over, placed on top of the machine, the

flexible tube removed, and another bar taken by the operator, who repeats the process continually. As the bars are pushed onward by the accession of those following, a current of air quickly dries the coating, and when they reach the other end of the machine they are received by another operator, who proceeds to coat the unfinished half of the pills in the same manner. The result of this process is a uniform thin coating that is perfectly soluble in the digestive fluids and entirely free from the perforations and other defects incident to the older method of impaling the pills upon needles and pins prior to dipping them in the gelatin bath.

The idea of administering medicine in the form of tablets had its inception in England in 1843, when William Brockdon took out a patent for the first tablet-shaping machine. The manufacture of tablets in the United States dates from 1864, when Jacob Dunton, a wholesale druggist in Philadelphia, was making them by means of a machine of his own design and patent. Charles Kilgore and John Wyeth were also pioneers in the making of tablets, and prior to 1877 they were called compressed pills. A complete history of the tablet industry has been compiled by Lyman F. Kebler,[1] who in the course of his narrative relates the following interesting incident, which was reported to him by Mr. Kilgore:

"'Compressed tablets' were commercially imported in 1854 by E. Milhau, a druggist of New York City, at the request of Commodore M. C. Perry, who first procured them in London. The Commodore was very

[1] *Journal* of the American Pharmaceutical Association, 1914.

anxious to take some of these medicines with him on his trip to Japan. Mr. Milhau did not have this form of medicament in stock, and was compelled to place the order abroad which resulted in considerable delay. The day Commodore Perry received orders to report at Hampton Roads for his final instructions, he called on Mr. Milhau and requested that he forward the compressed pills to him if they arrived in time to reach him before sailing. The goods were received in sufficient time to comply with his request."

In the early days of the industry the remedies offered in tablet form were principally the straight chemicals. The familiar chlorate-of-potash tablet was probably the first.

There are two classes of tablets in general use—compressed and triturates. The former may be either plain or coated. Compressed tablets represent a great variety of formulas and are made in some form of stamping-machine. Triturates are usually molded, though in some factories they are made by a stamping device.

The first step in the manufacture of compressed tablets is the thorough mixing of the ingredients, which is done in a revolving mill. Balls of some hard material, or agitators, reduce the drugs to a uniform powder, and in the process they are thoroughly blended with the excipient. The latter term refers to the various substances that take part in the composition of the tablet and give it body, to produce disintegration when ingested, and to act as lubricants when the material is later run through the stamping-machine. Sugar, gum, dextrin, or gelatin may be

added as adhesive agents. The body of the tablet may be obtained by means of kaolin, terra alba, or fullers' earth, which are usually termed "fillers." The disintegrating agent is usually starch. The lubricants commonly employed are talcum powder, boric acid, or liquid petroleum. Tablets that contain liquid medicating agents are treated with milk-sugar, magnesium carbonate, or powdered licorice root, which act as absorbent agents, though starch, which is universally employed as the disintegrator, also acts as a good absorbent.

When the mixture is sufficiently blended and pulverized, it is removed from the mill and subjected to the next stage in the process, known as granulation. The powder is mixed with a suitable liquid until slightly damp, and the mass is forced through a sieve of proper size. The granules are spread on trays and dried at a low temperature in a vacuum dryer, which resembles in appearance a huge safe.

After a granulation is satisfactorily dried, it is mixed with a further quantity of lubricant, again sieved, and if flavoring oils are to take part in the formula, they are now added. The granules are then ready for introduction into the stamping-machines. These interesting pieces of mechanism are so devised that a steady stream of material is fed from a hopper on to a rotating plate, where it is caught, and by high compression stamped into the permanent tablet form. There may be from ten to fifty stamps to a single machine, and the finished tablets are delivered like clockwork, at the rate of from 500 to 700 per minute.

Some special machines are capable of turning out as many as 1800 tablets in sixty seconds.

A compressing-room, when operating to full capacity, is a busy place. The steady, monotonous click of the machines converting the trays of granular powder into circular disks of various sizes with no apparent interruption, the hum of the shafting, and the rattle of the tablets as they are transferred to the big tin boxes cause one to pause and marvel at the developments that have taken place since Dunton, Kilgore, and Wyeth operated their hand-punches and single stamp-machines back in the sixties.

Tablets are coated with sugar or chocolate by the same process that is employed in coating pills. Sometimes the effect of chocolate is produced by mixing brown oxide of iron with the sugar syrup.

The manufacture of tablet triturates dates from 1861, when Dr. Robert M. Fuller perfected his process for compounding them. He did not exploit his invention commercially, but in the late seventies Caswell, Hazard & Company and Boericke and Tafel offered the first triturates to the trade.

Tablet triturates are the form in which calomel is popularly administered. Morphin tablets for making solutions for hypodermic injection are triturates, so prepared that they will dissolve in water almost instantly. Local anesthetics, such as cocain and novocain for dental use, are compounded in the form of hypodermic tablets.

Great care is observed in weighing and mixing the ingredients of tablet triturates. In many cases the in-

dividual tablet carries but a minute quantity of some very potent drug, perhaps one hundredth of a grain or even less. Hence, if an order calls for a hundred thousand units of this small grainage, it is essential that every precaution be taken to distribute the drug evenly through the excipient, which is usually milk-sugar, and that the weight of the mixture be adjusted, so that no more and no less than the prescribed quantity will be prepared.

The powdered mixture is moistened until it is pasty enough to be handled like fondant. Then, by means of a thin-bladed blunt knife, the operator spreads the paste on a thin plate of brass or gutta-percha. These plates are perforated evenly with perhaps a hundred or more cylindrical holes of exactly the size that the finished tablet is to be. The plate is laid on a glass table-top. Any superfluous paste is scraped off, and the plate is then transferred to a dryer, where it stays until the moisture has evaporated. Skilled workers fill several hundred of these plates in the course of an hour's work.

When the drying process is complete, another operator takes the plate and presses it down on a forest of little rigid plugs just the size of the holes in the plate, and so coördinated that they fit accurately into each little aperture. In this way the tablets are forced out and can be brushed off into the bulk-container.

We are all familiar with the little gelatin globules, or *perles,* which are often colored red or green or yellow, and contain some liquid medicine like castor or sandalwood oil. They are usually firmer and more

resistant to the pressure of the fingers than the softer oval-shaped capsules employed for administering the same kind of medicines; but both are made in the same way. The elasticity of the gelatin depends upon the way it is manipulated prior to stamping out the capsules. It is dissolved in a steam-jacketed kettle with the proper proportion of water and glycerin, and when the consistency is right the hot liquid is fed out under a knife-edge on to the surface of metal plates about eight or nine inches square. The plates are transferred to racks in a drying-oven and dried for twenty-four hours.

When the gelatin film has reached precisely the right degree of dryness, which is determined by the operator through the sense of touch, the films are stripped from the plate and laid on a metal mold filled with oval openings for the capsules and with round openings for the globules. The edges of the mold are raised somewhat, so that the gelatin film makes a kind of tray into which a measured quantity of the liquid that is to be inclosed in the capsules is poured. Another film of the gelatin is placed on this liquid, the other half of the mold placed on the top, and the two halves of the mold slipped into a power-press, where it is subjected to a pressure of some twenty tons to the square inch.

When removed from the mold the capsules or globules appear in perfect form, but attached to the shreds of gelatin still left. They are then separated, rinsed several times in gasoline, dried, and put into boxes for shipment.

Even more interesting than the manufacture of the

globules and soft elastic capsules, is the process of making the hard capsules used as a medium for dispensing powders of some of the valuable and potent drugs, such as quinin sulphate, and aspirin. The machines for making these familiar articles are complicated pieces of mechanism that work with clock-like accuracy and precision. From start to finish the capsules are not touched by human hand.

Rows of accurately ground phosphor-bronze pins approach the trough of melted gelatin. The latter automatically rises and covers the pins, then slowly drops back, and the bars of pins move on, turning as they go to prevent the warm gelatin from running down the sides, which would result in thin-headed capsules. These rows of pins are then carried into a long cooling-chamber, where the hardening takes place in the presence of washed air with which each in-indiviual machine is supplied. Sprocket-carrier chains convey the impaled capsules slowly to the back and up to the top of the machine, and from there they again approach the starting-point.

As the bars reach the front of the machine the operator removes them, placing those containing caps in one horizontal slot and those containing bodies in another. These bars drop down simultaneously; grippers seize the hardened shells of both the body and the cap, and force them into openings in circular disks. These disks are of the exact thickness one of the capsule body and the other of the cap, and they overlap each other slightly.

A rotating knife trims the rough edges of both body and cap even with the flat surface of the disks, or

wheels, as they revolve, and then, as the two parts of the capsule are exactly opposite each other, the body and the cap are pushed gently but firmly together, and the capsule is now entirely finished.

A capsule-filling machine is perhaps the most unusual piece of apparatus in the factory of the manufacturing pharmacy. It is almost human in its operation, and decidedly more accurate. It is fitted with one hopper for holding the empty capsules, and another for the medicament that is to be contained in them. When all is ready, the power is turned on and the process begins. An empty capsule falls down a tube from its hopper into a little slot where the body is held by vacuum, the cap is clasped by finger-shaped clamps and lifted off, just the right amount of powder falls into the body, the cap is pushed back in place, the vacuum is shut off, and the filled capsule falls to one side into a box. The entire operation consumes but an instant of time and is entirely automatic. After adjusting the machine so that it will deliver the proper quantity of powder, the operator has nothing to do but see that the hoppers are replenished, from time to time, with more empty capsules and more powder.

The machines turn out many thousands of filled capsules a day, and in the larger factories have replaced the old laborious method of hand filling.

In making ointments and cold creams the aim is to produce a smooth, uniform preparation in which the drugs are evenly distributed through the unctuous base. Various substances of an oily nature, such as petrolatum, lanolin (pure wool grease), or lard, sometimes stiffened with a little paraffin or beeswax, and

smoothed out with poppy- or cotton-seed oil, are melted together. The mass is transferred to a mixing-machine fitted with revolving blades, and the medicating agents, coloring matter, and perfumes added. The ingredients are thoroughly incorporated with one another in this apparatus, and the semi-fluid mixture is then transferred to a paint-mill, from which the smooth ointment emerges in a thin stream. Sometimes it is necessary to pass the product several times through this mill in order to break up and mix the particles of solid that would otherwise cause a gritty sensation when the ointment is rubbed on to the body.

Tooth-pastes are prepared in the same way; but these are usually made up on a glycerin or sugar base instead of the fats and oils that characterize ointments.

The general principles of making fluid and solid extracts, pills, tablets, capsules, and ointments that have been outlined in this chapter are employed in all the manufacturing pharmaceutical plants. Formulas of special nature may require special procedures in order to yield a product of the right character. Certain types of medicines require unusual care and conditions for their safe and successful production. Lithia tablets must be made in a room where the air is dehumidified, otherwise they will spoil. Methylene-blue capsules must be prepared in a building set apart from the rest of the factory, in order that this substance, which contaminates everything near it, will not spoil other preparations. Bichloride of mercury tablets must be manufactured in a unit separate from the general tablet plant, in order that the dangerous drug may not accidentally become mixed with the ingredi-

ents of the numerous other formulas that are being prepared.

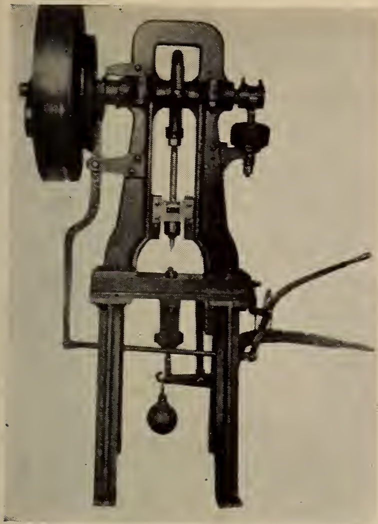
Very elaborate equipment is often installed for compounding special preparations, but the general principles of grinding the drugs, macerating, percolating, and mixing, are the same, no matter what may be the medicine finally evolved. When a formula calls for the blending of a number of different liquids with perhaps some chemical to be dissolved in the solution, it is usual to dissolve the substance in water or alcohol and then transfer the liquor to a large mixing-tank fitted with a mechanical stirrer. The stirrer consists of a number of paddles set at different angles on a vertical shaft and rotated by power. The various components are added separately and the mixture agitated until it is uniform in character. These mixing-tanks often have a capacity of five hundred or a thousand gallons. Beef, iron, and wine preparations, elixirs, syrups, essence of pepsin, liniments, etc., are made up in this way.

Emulsions are medicines designed for the administration of some viscous oil in a finely divided state and in a palatable form. They often contain chemical salts such as the hypophosphites. It is essential that there be present a certain proportion of a so-called emulsifying agent, usually a gum or albumin with perhaps a little gelatin. The most familiar emulsions are those that contain cod-liver oil or liquid petroleum, and the oil content may run from 25 to 50 per cent., the balance consisting of water, emulsifying agent, inorganic salts, and flavor.

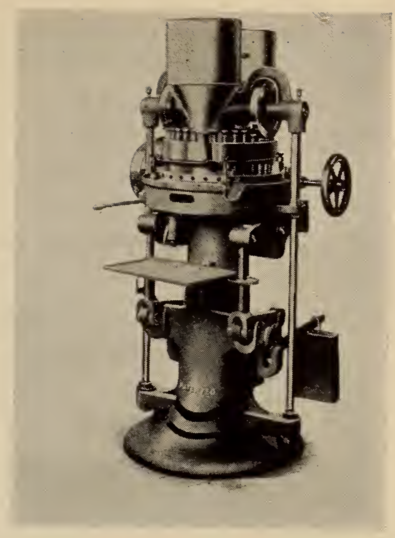
The first step in the process of manufacture consists in making a uniform mixture of the gum or mucilage of the emulsifying agent with a part of the oil. This is put into a stirring-machine arranged like an enormous egg-beater, and when the proper rate of rotation is developed the balance of the formula is gradually added. First a portion of the water with the salts in solution is thoroughly incorporated, then more oil, then more water, and so on until at last, when all the bulk ingredients are in, the flavor is added. The better grades of emulsions are run through homogenizing-machines. By means of these pieces of mechanism the viscous liquid is forced at an enormous pressure in fine streams against metal plates, whereby the oil globules are divided into infinitesimal particles, and the emulsion becomes so uniform that it is as smooth and fluffy as the finest whipped cream, and never separates.

In some of the large medicine plants concerned with the manufacture of only one specialty, the arrangement of the apparatus and machinery is such that the compounding of the different ingredients of the preparation is progressive. If it is a liquid, the first step of the process being completed, the percolate, or whatever the form may be, is pumped through pipes into the receptacle where the next operation is to take place. Sometimes there may be as many as a dozen different steps before the finished product finally emerges. It is the usual thing to prepare a batch, say, of 1500 gallons at a time, and the plant is so constructed that it can take care of the work in a convenient unit of time.

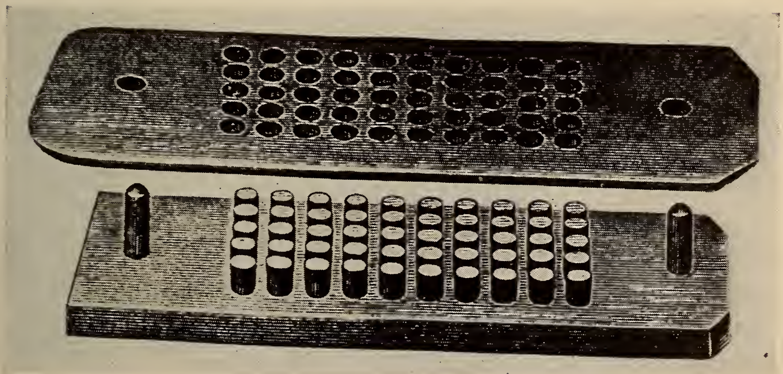
Most of the popular legitimate liquid patent medi-



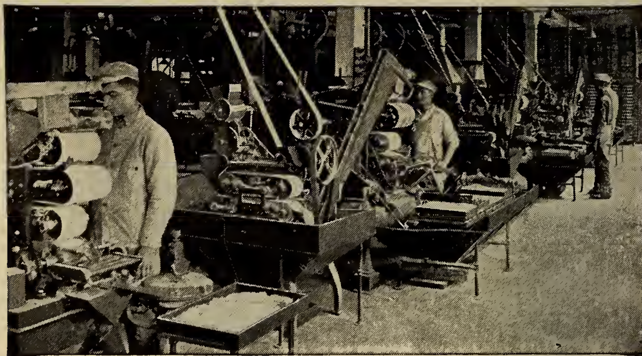
FIRST AUTOMATIC TABLET-PUNCHING MACHINE USED IN AMERICA AND STILL IN USE



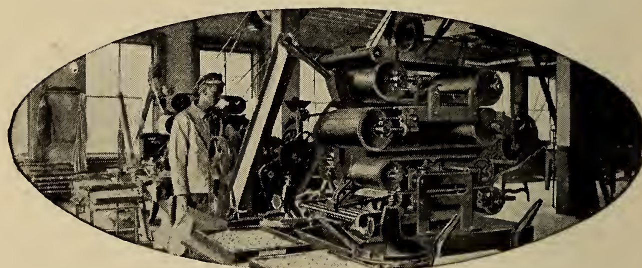
MODERN ROTARY PUNCH TABLET MACHINE



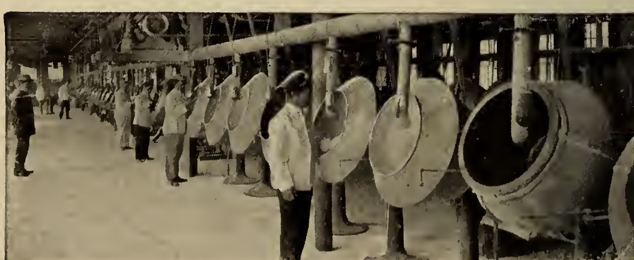
MOULD FOR MAKING TABLET TRITURATES



A Row of Pill Machines



A Single Machine



Coating the Pills

HOW PILLS ARE MADE

cines are made according to this program. A good example is the case of Lydia Pinkham's Vegetable Compound, which is made in one of the best equipped medicine plants in the world. The factory is open to visitors, who are shown the entire process from the time the various crude drugs are ground up, preparatory to percolating, until the finished medicine is bottled. The ground drugs are first moistened with the solvent, which consists of diluted alcohol. After a sufficient period has elapsed and the valuable components of the drugs have been brought into solution, the mixture goes into a battery of percolators, from which the liquid is drawn off. Water is introduced to wash out the solvent adhering to the drug particles, and this is continued until enough has been run through the percolators to bring the alcoholic strength of the entire batch down to the amount that has been found necessary to keep the finished preparation from spoiling. After passing through an elaborate pasteurization and filtering system, the medicine is stored in immense glass-lined metal tanks, being kept there not less than three weeks before being bottled. It is then pasteurized again, and run down to a tank over the bottling-room, from which it is drawn directly into recently sterilized bottles. The bottling-room is inclosed from the rest of the plant, and, to render the conditions as aseptic as possible, the air that enters the room is filtered so that it is free from contaminating microörganisms, wild yeasts, and mold-spores.

Individual factories usually feature unusual pieces of equipment. They may be special machines for

automatically filling the bottles with pills or tablets. The devices are so constituted that the pills are received in measured quantities from a hopper, run down a spout into a waiting bottle, which is pushed aside and corked. Another bottle is ready to receive another shower of pills, and so the process continues, the operator from time to time filling the hopper with pills and the bottle-feeder with an endless supply of containers.

Filling-machines force accurately measured amounts of tooth-paste, cold cream, glycerin jelly, and emollients of all sorts into collapsible tubes. Another kind of automatic filler is used for filling cans with talcum powder, zinc stearate, etc. Machines with molds of various shapes, and working at great pressure, convert mixtures of cocoa butter and other drugs into suppositories. Intricate mechanism, equaling a dozen hands in its capacity for work, attaches the labels to the bottles with an unfailing nicety, surpassing the human touch.

In every pharmaceutical house of any pretension at all, the drugs and chemicals are examined by a corps of skilled chemists and their identity and purity established before they are made up into medicines. Many of the operations are subject to analytical control, and the finished products are tested, either chemically or physiologically, in order that their compliance with the proper standards may be assured. Research chemists are constantly at work striving to eliminate defects in manufacturing details, developing better methods of

purification, and evolving new products or valuable derivatives of those already in use.

The modern medicine-maufacturing plant is a development of the past seventy-five years. The ever-increasing demand for agents that make sick men well has taxed the ingenuity of the scientists and the mechanician. One has evolved the numerous types of standard remedies and the myriad meritorious formulas; the other has invented and perfected apparatus required to produce preparations of stable and uniform character in large quantities. Medicines to-day must be made of materials of the highest quality obtainable, attractive in appearance, unfailing in their remedial action, and so carefully standardized that the physician can with assurance anticipate what to expect from their administration. Their supply must be unfailing, which means that adequate stocks of the thousands and thousands of formulas and combinations must be kept in reserve by the manufacturer and wholesaler. The dispensing pharmacist long ago ceased to be a factor in the preparation of medicines for general distribution. The pace was too severe. The factory, with all the advantage of systematic management and labor-saving machinery, has been the logical evolution.

CHAPTER IV

THE RÔLE OF ALCOHOL

In the chemical industries the employment of certain substances is essential for the successful conduct of various reactions that finally consummate in the finished products. These substances may or may not function in the makeup of the things they assist to create. The dye industry could not exist without an unlimited supply of sulphuric acid, and it was not until a very cheap form of this acid was obtainable from a commercial contact process, invented about 1889, that it was possible for the Germans to prepare artificial indigo at a price that could compete with the naturally grown dye. Before this accomplishment the source of the extensively used dye-stuff had been the leaves of the indigo plant, which was grown for the purpose in enormous quantities in India. In our Southern States commercial fertilizers are made from huge deposits of phosphate rock by the action of sulphuric acid, which decomposes the mineral, setting free the valuable phosphates in a form that is readily taken up by growing plants. In the first-named industry the acid acts almost solely as a reagent and is not an essential part of the finished dye, but in the fertilizers most or all of the acid remains in an altered and non-corrosive form.

In the medicine industry, which is really only a

branch of the chemical industry, there is one agent that stands out above all others making for its development, and that is alcohol. Without alcohol the preparation of drugs and medicinal chemicals, with their present high state of refinement, would have been impossible. If deprived of alcohol the makers of medicines and high-grade chemicals would be unable to conduct their business; the industry would languish and eventually perish.

This may appear to be an absurd statement, but a few minutes' thought will confirm its correctness. It may be asked how the supply of alcohol concerns the millions and millions of pills and tablets, effervescent salts, powders, and other things of like sort that are sold all over the country, and that contain no alcohol or any other liquid in their make-up. There is hardly a pill or tablet formula that does not contain some valuable ingredient, either in the form of a drug extract, which has been obtained from a crude drug by means of alcohol as a dissolving agent; or an alkaloid or other pure substance made by a process that had necessitated the use of alcohol as either a crystallizing medium or a reacting component. If alcohol had not assisted in shaping the ingredients, the pills and tablets could not have been created. Then, there are the many liquid preparations, standard fluid extracts, tinctures, liquid tonics, digestives, and other specialities numbering into the thousands, that require alcohol to hold their remedial principles in solution and keep the preparations from spoiling. Nothing else thus far discovered has been able to supplant alcohol as a basic material for the medicine industry.

The general public is more or less familiar with three kinds of alcohol—grain, wood, and denatured. Grain alcohol is the one that is necessary to the medicine industry, though special formulas of denatured alcohol, which depend upon grain alcohol as a basic constituent, have an extended use, either in certain types of intermediate operations leading up to a non-alcoholic galenical preparation, or as a component functioning in the finished product. The whole question of denatured alcohol will be discussed later in the chapter.

Grain alcohol is known to the chemist as ethyl alcohol, and is one of a group of chemical substances of the organic series that resemble each other in their general reactions, and are known as alcohols. The grouping of the atoms in the molecule of the substances determines the alcohol characteristics, and the only difference in the composition of the members of the series is the number of carbon and hydrogen atoms. Wood or methyl alcohol has the smallest molecule; in fact, it is impossible for the chemist to conceive of a true alcohol with a lower molecular weight, as the term is, in organic chemistry. Ethyl alcohol is the next member in the series, and differs from methyl alcohol in having one more carbon and two more hydrogen atoms. Then, on going up the series, we pass over two or three alcohols of little importance, and come to the amyl alcohols, of which there are eight, all of the same size molecule, but differing in the way the atoms are arranged, though the particular group on which the "alcoholic" characteristics depend is the same in all of them. The amyl alcohols, with some of those inter-

mediate between them and ethyl alcohol, comprise the fusel oil which is so feared by the whisky-drinker—or perhaps it would be better to say, not by the confirmed whisky-drinker, but by him who takes it occasionally, and for medicinal use only.

The molecule of methyl alcohol contains one atom of carbon, one of oxygen, and four of hydrogen. Ethyl alcohol contains two carbon atoms, one oxygen, and six hydrogen. They may be expressed graphically as follows, and a glance at the formulas will show how closely they are related:

CH_3OH	Methyl alcohol	(wood alcohol).
CH_3CH_2OH	Ethyl alcohol	(grain alcohol).

The two atoms presented in the form "OH" determine the alcoholic character from the chemist's point of view. They constitute a group which in organic chemistry is called hydroxyl. This group is always present in a true alcohol. It causes the substance containing it to have certain specific reactions toward other substances. When we find a substance possessing these properties to the exclusion of those that characterize other well defined groups of substances, such as acids, we place it in the alcohol family.

Grain alcohol is so designated because its preparation has from time immemorial been known to depend upon the use of rye, corn, and other starchy grains. As a matter of fact, any starch-containing product will yield alcohol when properly treated. Potatoes furnish a cheap and abundant source, and most of the alcohol made in Germany comes from these tubers. The development of the alcohol industry by the Germans, which resulted in an almost unlimited supply of the

commodity, is one of the reasons why the chemical industry has attained the commanding place that it has among the German industries. But, in order to yield alcohol, starch from any source must be converted into sugar—not the familiar cane-sugar, which is not fermentable, but into a simpler variety of sugar. Because it is necessary first to get sugar before alcohol can be made, it transpires that one of the best sources of alcohol is now the refuse molasses of sugar factories.

In the old days the conversion of starch to sugar was brought about by the action of a ferment on the moistened grain. Diastase was the ferment employed, and it was added to the grain in the form of ground malt. Diastase belongs to a group of substances called enzymes. They are also termed "unorganized ferments," because they do not appear to act in reproducing themselves, as yeast-cells do. Yeast is an organized ferment, a vegetable growth, and takes part in the second stage of the alcohol process, though recent investigations indicate that yeast itself contains an unorganized ferment to which its activity may be actually due. At present the starch conversion is brought about largely through the aid of dilute acids, which have the property, too, of changing starch into simple sugars. When molasses syrups furnish the crude material, the conversion of the cane-sugar to the simpler forms is also brought about by acids.

From whatever source the sacchariferous mixture comes, be it from grain, potatoes, or molasses, there is only one way that the conversion to alcohol can be brought about, and that is by the use of yeast. The

yeast must work on the simple sugars until they have all been changed, and during this process large quantities of carbonic-acid gas are produced. Some of the higher alcohols are produced in small measure, and when the mixture is later subjected to distillation, they come over with the other volatile substances, constituting the fusel oil to which we have already referred. Alcohol is not created by distillation, as many people seem to think. It results from the workings of a naturally living body, analogous to a bacterium, or perhaps a vitamine, to which subject considerable space is devoted in a later chapter. Without yeast we should have little or no alcohol, and that which we might obtain would be more or less of a chemical curiosity. Wood alcohol is produced only by a process of distillation; it cannot be obtained by the aid of yeast, and the distillation process by which it is made is of an entirely different character from that employed in separating ethyl alcohol when the conversion of the sugar is completed by the yeast.

The separation of the created alcohol is a purely mechanical process. The unsightly mixture resulting from the yeast fermentation is placed in a large still and heated. When the temperature rises sufficiently, the alcohol and some of the water become vaporized, rise from the bulk of the mass, and pass over into a condensing device, from which emerges a crude mixture of alcohol, water, and various other substances. By rectification most of the water and all of the other impurities are eliminated, and a product containing from 94 to 96 per cent. ethyl alcohol results. This is the alcohol of the medicine-maker.

In the national prohibition law alcohol is classed as a liquor. Its manufacture, sale, and use is surrounded by a mass of regulation that causes much hardship and dissatisfaction to the legitimate users. Prohibitionists look upon alcohol as a beverage, while those interested in the production and use of the commodity maintain that it is not a potable substance. Strictly speaking, the claims of neither side are justified. Alcohol of full strength cannot be imbibed, but it can be diluted to a degree that will render the mixture unobjectionable; so, if the spirit of the Eighteenth Amendment is to be carried into effect, it is probably inevitable that the alcohol trade will have to suffer the imposition of certain restrictions. The unfortunate circumstance is that alcohol as a medium for the manufacture of drugs and medicines has to be treated as a liquor in the same way as whisky, wine, and other alcoholic beverages. Hence it ought to be made the subject of special provisions and methods of administration; its legitimate use facilitated and not hampered, as is now the case.

Pure alcohol possesses a happy combination of properties that make it an ideal agent for preparing drugs and medicines. It has a slight and unobjectionable odor, and is virtually tasteless. It mixes freely with water. It dissolves most of the valuable principles from the vegetable drugs, leaving behind the inert and useless portions that usually predominate. It resists the action of microörganisms, which are the cause of spoilage, and, when incorporated into liquid mixtures in the proportion of 18 per cent. or more, will protect them indefinitely from the deleterious

actions of these bodies. It does not solidify even at the extreme temperatures of the severest winters; hence its presence in reasonable quantities in liquid preparations serves to protect them from freezing and consequent loss through breakage of bottles and other unpleasant accompaniments. It has a comparatively low toxicity—so weak, in fact, that it is not apparent or even a matter for consideration in judging the potency of a medicine in which it functions. As an intermediate for dissolving valuable substances, separating them from others, or holding them in solution until they slowly crystallize, it fills many useful purposes in the plant of the chemical and medicine manufacturer. It can be produced at a reasonable cost and can be made available in unlimited quantities.

The high tax on pure alcohol has prevented its use for many purposes where otherwise it would have been employed. It costs perhaps twenty cents a gallon to make, but each gallon is taxed as high as four or five dollars, and some grades even higher, so that the price the user has to pay determines in a large measure the extent of its application. Fortunately for the industry, the policy of providing tax-free denatured alcohol for special manufacturing purposes has lifted the burdens of the manufacturer to a certain degree, and the future outlook in this direction is bright.

Broadly speaking, there are two classes of liquid medicines in which alcohol functions as a part of the finished product: those for internal and those for external administration. The former may be further divided into those preparations that are prescribed

at full strength or diluted with perhaps a volume or two of water, and those of which only a few drops are added to a considerable quantity of water before taking. Internal medicines that are used at full strength or at moderate dilution seldom contain more than twenty per cent. of alcohol. Those prescribed in small quantities, and which often contain highly potent remedial agents, may contain fifty per cent. or more alcohol. Such medicines are not handled to any extent as popular remedies, being usually high-potency fluid extracts kept by the retail druggist for prescription work. Liquid medicines employed externally usually contain at least 35 per cent. alcohol, and it may run up to 80 or even 90 per cent.

Liquid remedies need at least 18 or 20 per cent. of alcohol to keep them from spoiling, unless they contain other preservative agents that inhibit the growth of microörganisms. Even then a reduction in the quantity of alcohol cannot be contemplated if the ingredients are of such a nature that this agent is needed to keep them dissolved. Many valuable potent drugs are soluble only in alcoholic mixtures of relatively high strength. That is the reason that liniments, antiseptic washes, gargles, and preparations of this sort that fall in the class of external remedies require a goodly proportion of the solvent.

Most of the standard medicines of the Pharmacopœia and the National Formulary contain more alcohol in their make-up than do the popular remedies that are sold for self-administration. The tinctures of camphor, iodin, and ginger, all of which are indispensable remedies, are necessarily of high alcoholic

strength; otherwise the valuable ingredients on which their remedial value depends would not be held in solution. The compilers of the Pharmacopœia and the National Formulary are representatives of the professions of pharmacy and medicines, who meet in convention once in every ten years for the purpose of revising those standards on which the practice of pharmacy and medicine are based. One group of specialists prepares the Pharmacopœia, another the Formulary. The standards finally adopted are published in book form, and are authoritative for the ensuing decade. Both authorities are now recognized in the law of the land. The work of the Bureau of Internal Revenue in the administration of the prohibition law, and of the Department of Agriculture in the administration of the Food and Drugs Act in so far as it relates to drugs and medicines, is based on the standards prescribed by the Pharmacopœia and the National Formulary. So there is ample authority, based on the recommendation of the highest scientific talent and recognized by our law-making bodies, for the existence of medicines with high alcoholic content.

It can be asserted with authority that no legitimate liquid medicinal preparations made in this country to-day contain more alcohol than is absolutely necessary. The policy of the makers of medicines in recent years has been to reduce alcoholic content wherever possible. They are urged to do this from ethical as well as from commercial motives. The proposition of wholly or partially substituting alcohol has been made the subject of exhaustive study. It has been

found that many preparations that formerly contained considerable quantities of alcohol can, by proper manipulation, be presented in a non-alcoholic form or with a greatly reduced alcoholic percentage. This does not necessarily mean that the use of alcohol has not been required in any stage of their preparation, because this agent may be necessary and desirable for conducting the stages of manufacture leading up to the finished product.

In some medicines of low alcoholic content it has been found that glycerin as a partial solvent and a partial preservative is a satisfactory and readily available substitute. Its employment in most cases, however, must be reinforced by other agents, both for keeping certain ingredients in solution and to prevent the product from spoiling.

There are, however, certain types of reconstructive tonics and elixirs, containing strongly combined metallic salts and alkaloidal salts, from which alcohol can be easily eliminated, and glycerin substituted, and in some cases the addition of other preservatives is unnecessary.

When we come to the vast legion of formulas containing vegetable drugs, the problem of substitutes becomes complex, and each combination is a research in itself. There are several ways of bringing about the solution of the essential ingredients and the incorporation of the extract into a finished product. With some formulas direct percolation with relatively strong glycerin menstrua, augmented perhaps by the addition of mild alkali or weak acid, depending on the nature

of the drugs, will effect the desired results. The glycerin extract can be combined with the other ingredients of the formula, and the whole adjusted to the desired proportion. With others a preliminary percolation must be made with alcohol, and the solvent recovered, the syrupy extract being taken up in the glycerin and then diluted. Again the alcoholic percolate must be mixed with glycerin and the volatile solvent recovered, on the theory that it is easier to keep something in solution than to bring it down to solid form and then try to dissolve it again.

It has been surprising to note how many vegetable drugs will yield to water alone the great bulk of the valuable constituents on which their therapeutic activity depends, and when the solvent action of water is combined with that of glycerin and other common agents, to observe how many will yield good medicines without the presence of any alcohol.

As a general proposition glycerin alone, in a liquid medicine compounded with mixed drugs, cannot be depended upon as a preservative. Of course, if it were used in amounts of 50 per cent. or more, perhaps this generalization would not apply; but products containing this quantity would in few instances be practicable, and would usually differ so in appearance from the original formulas that the trade in them might be affected.

Mixtures containing sugar are difficult to preserve with glycerin, and the presence of certain drugs will support spoilage organisms even when 35 per cent. or more of glycerin is used. When sugar has been used

to give "body" to a product, as well as a certain sweetness, it can be eliminated or reduced considerably by the addition of glycerin; and where a certain degree of sweetness is essential, any reduction of this quality due to the lack of sugar can be made up by a minute amount of saccharin.

When we come to the substitution of alcohol in products where it has been necessary to use 35 per cent. or more of the solvent, an entirely different set of conditions is presented. Very few of the well known substances will dissolve essential oils, camphor, menthol, and the like, and still mix with water. Acetone mixes with water, and has been used successfully in external remedies, such as liniments and pain-killers, where the odor has been masked by the presence of highly aromatic oils. But there is a prejudice against its use in any remedy that might be capable of internal use, owing to its supposed toxicity. From experiments recently conducted, it would appear that the toxicity of acetone has been exaggerated, and that the reports of its toxicity may have been due to the fact that it is found in the excretions accompanying certain diseases, rather than to any actual proof of deleterious effects caused by ingestion.

Among the chemical industries we find alcohol playing a major rôle in the production of ether. This invaluable anesthetic contains in its molecule two groupings derived from alcohol, which are known to the chemist as the ethyl groups. These assemblages of atoms are united by an atom of oxygen, producing a substance that bears no resemblance to alcohol in the way it acts toward other bodies. A glance at the

following graphic formulas will explain the relationship of the two bodies:

CH_3CH_2OH, alcohol.
CH_3CH_2, usually written C_2H_5, ethyl group.
$C_2H_5.O.C_2H_5$, ether.

It is made by the action of sulphuric acid on alcohol. The two ingredients are combined in the proper proportions, and after an interval has elapsed, during which an intermediary body is formed, the mixture is heated in a still, and ether begins to pass over through a condensing-worm. More alcohol is constantly added and the process continued indefinitely, alcohol going into the still and ether coming out at the end of the condenser. Enormous quantities are used annually, the grade of highest purity in the hospitals and dispensaries, the less highly refined in the arts and industries requiring its use as a solvent for special purposes, and for removing the alcohol in the final process of the manufacture of gun-cotton and smokeless powder.

Hundreds of high-grade synthetic chemicals, many of which, like sulphonal, veronal, phenacetin, ethyl chloride (a commonly employed local anesthetic), chloral, and novocain, are valuable medicinal agents, contain ethyl groupings in their molecules. Alcohol is the only commercially available source of the ethyl group.[1] Without alcohol these bodies could not be

[1] Processes have been developed in recent years whereby ethyl-containing compounds are being recovered from the natural gas of some of our Central and Middle Western States. By this means a new source of the important ethyl radicle has been made available, and may continue to be drawn upon as long as the natural gas continues to flow.

made; in fact, synthetic organic chemistry would be at a standstill.

The early recognition by Germany of the importance of alcohol for use over the wide field that has been outlined in the foregoing paragraphs, and the encouragement of its production by every possible means, led to the phenomenal development of her dye and chemical industries. To quote a national authority on the alcohol situation, James M. Doran[2] of the Bureau of Internal Revenue, "It might well be stated that without Germany's alcohol and allied chemical industries her military and economic defense would have crumbled two years before the armistice."

When the authorities in other countries became alive to the state of affairs in Germany, and saw that her supremacy in the dye and synthetic chemical field was imminent, steps were taken to adopt some means by which cheap alcohol could be made available for the industries, in order to compete with the government-produced, excise-free product being supplied to the German manufacturers. It must be borne in mind that in this country the Treasury has always derived a large revenue from distilled spirits, and a code of revenue laws was enacted years ago that is without parallel in its minute supervision of all phases of the industry. Manufacturing operations depending upon the use of alcohol could be developed only under great hardships, due to the incubus of the beverage tax laws. The same general conditions have prevailed in Great Britain.

In order to reconcile the needs of the country for

[2] *Chemical Age*, 1920, p. 317.

a source of revenue and the needs of the manufacturing interests for a cheap form of alcohol, provision was finally made in 1906, by Congressional action, whereby denatured or industrial tax-free alcohol was made available for certain limited purposes. As the years have gone by, the privilege of using denatured alcohol has been extended, until to-day there is more of it consumed than tax-paid alcohol. In 1917, our great war year, 55,000,000 gallons were used, and in 1919 approximately 35,000,000 gallons, which may be considered a fairly normal average for the industries at their present stage of development in peace times.

The expression "denatured alcohol" is not well understood by the public. The idea is prevalent that it means something poisonous, and there are good reasons for this deep-rooted belief, due to the press reports that from time to time have detailed lurid accounts of the dire results attending the accidental or intentional drinking of denatured alcohol. In order to clear up the confusion of the meaning of the term, it should be stated that our alcohol laws provide for two classes of denatured alcohol: (1) completely denatured alcohol, of which there are at present five different formulas, and (2) specially denatured alcohol, of which there are some forty or more authorized. Completely denatured alcohol is the commodity that reaches the general public as a fuel for spirit-lamps, for use as an anti-freezing agent for automobile radiators, for bathing and rubbing, for dissolving varnishes and shellac, and for many other purposes common to everyday life and activity. Specially de-

natured alcohol can be used only for special purposes and under somewhat restrictive conditions.

Until recently the formulas granted have been for alcohol taking part in manufacturing processes, the finished products themselves containing no alcohol. But within recent years the scope has been greatly extended, and now there are several formulas of denatured alcohol that are sanctioned for use in developing preparations which contain the alcohol when ready for market. The theory along which this development is taking place is the addition to the alcohol of some material that will prevent its use as a beverage, while enhancing its value for commercial purposes. The denaturing substances, while rendering the alcohol unfit to drink even when diluted to a potable strength, are not necessarily of a toxic nature; in fact, when the denatured alcohol is to function in a finished preparation, one of the conditions prescribed is that the substances added must not make it unduly dangerous.

To summarize the present situation, we have completely denatured alcohol for general use, prepared with the addition of ingredients that render its use as a beverage impossible. We have specially denatured alcohol for use solely in manufacturing processes, usually denatured with some substance that functions in the preparation of the material. Finally, we have specially denatured alcohol for making various articles of the trade, where the alcohol remains in the product along with denaturing agents.

It is unfortunate that the original basic denaturant authorized in this country was the substance wood alcohol. It has always been looked upon as a poison-

ous agent, and with considerable reason; for there are many fatalities resulting from the drinking of the alcohol and preparations made from it. Because of these accidents the terms "denatured alcohol" and "poison" have become closely associated in the public mind. The original formula was revoked early in 1919, and the last completely denatured alcohol authorized, Number 6, contains no wood alcohol whatsoever. But no concern need be felt because specially denatured alcohol is employed by the trade in the preparation of various commodities. In those preparations where advantage has been taken of the privilege to use a special denatured alcohol to develop a finished liquid, such as a liniment or hair tonic, the denaturing agents, while rendering the alcohol unfit to drink, are relatively innocuous, and the preparation is no more dangerous because denatured alcohol is employed than it was when pure tax-paid alcohol was used as the dissolving medium.

It would not be fair to the public to permit this general statement to go forth without qualifications, because not long ago a specially denatured alcohol was authorized, for use in making perfumes and toilet waters, which depends on a substance known as brucin to make it unfit to drink. Brucin is very bitter and belongs to a class of substances known as alkaloids. It occurs in nature with strychnin in the drug nux vomica, to which it is closely related in its chemical structure. When strychnin is extracted from the crude drug and purified by the manufacturing chemist, brucin is a by-product. Heretofore it has been of scarcely any importance commercially, but its intense

bitterness and availability in fairly large quantities suggested its use as a denaturing agent.

Whether or not there is justification for the use of this substance in a class of articles that have such wide distribution as perfumes and toilet waters can be judged only by the happenings of the future. As we have stated above, brucin is closely related to strychnin, the toxic nature of which is too well known to be emphasized. It is used more extensively for destroying predatory animals than for any other purpose, the customary method being to mix the strychnin with a holding substance such as fullers' earth and a sweetening agent such as saccharin, the combination then incorporated into a mass of moist grain, ground meat, or blood, depending on the nature of the animal to be put out of the way. The theory of the practice is that the fullers' earth will cover up the bitterness of the strychnin for a sufficient period to permit the ingestion of enough material to kill the animal, the saccharin providing a further disguise and a certain amount of palatability. Government investigators engaged in the work of controlling the predatory creatures, wolves, coyotes, gophers, ground-squirrels, and the like, have experimented extensively with brucin, with the idea of substituting it for strychnin. Their researches have shown that, while brucin seems to act as efficaciously as strychnin as a killing agent, its bitterness is of such a character that it is not sufficiently obtunded to permit of the ingestion of a toxic dose before the creature is aware of its presence and disgorges the mixture. Their reason for not recommending brucin as a killing agent has not been because

of its lack of toxicity, but because the animals could not be made to take the bait. There are commercial mixtures on the market for destroying animals, which consist of equal parts of strychnin and brucin, and which appear to be just as efficacious for the purpose as strychnin alone. So there the situation rests to-day.

At this point in this discussion we will insert a few remarks explaining what wood alcohol is. In telling about grain alcohol it was said that the creation of this substance was brought about by the action on certain sugars of an unorganized ferment existing in the cells of the yeast. In other words, it is a natural creation, not a product of synthesis or artificial manipulation of any kind. Wood alcohol, on the contrary, is produced by an artificial process that depends on heating wood or any vegetable substance containing a large quantity of cellulose (wood-fiber) in a closed container out of contact with air. The process is known as destructive distillation, the heat applied being sufficient to break up the complex cellulose molecule, containing a large number of carbon, hydrogen, and oxygen atoms, into a number of simpler substances of comparatively low molecular weight. The bodies in the form of vapor pass over into a condensing-tube, where they are liquefied and run out from the end of the apparatus as an evil-smelling liquid known as pyroligneous acid. Among the products composing this liquid are water, acetic acid, acetone, methyl alcohol, cresols, aldehydes, and other organic compounds. The acid is neutralized with lime, and the acetone, methyl alcohol, and other volatile constituents

distilled off. Some of the acetone and perhaps part of the other pungent principles are removed, leaving a yellowish, highly flavored, and odorous liquid with 80 per cent. or more of methyl alcohol; and this is what is known as wood alcohol. The constituent present in largest amount is methyl alcohol; but whether or not the intensely toxic character of the product can be ascribed to this principle alone has never been definitely determined.

Pure methyl alcohol has been an article of commerce for more than a quarter of a century. Its use in medicines, except in a few preparations for external purposes, has been limited, and it is seldom if ever employed at the present time. It is not strictly fair to call this substance "wood alcohol," because the name really designates the complex impure mixture described above. Methyl alcohol is relatively odorless and tasteless, and when highly purified can be distinguished from ethyl alcohol only by laboratory test. It has an important place in chemical manufacturing, as it furnishes the methyl group for developing synthetic bodies, just as ethyl alcohol supplies the ethyl group where it is needed. Artificial oil of wintergreen, which has almost entirely supplanted the natural oil, is methyl salicylate, obtained by the inter-reaction of methyl alcohol and salicylic acid. But for solvent purposes it possesses no merit beyond that of the comparatively innocuous ethyl alcohol, and, in view of the doubts with which its character is surrounded, there is no good reason for employing it when ethyl alcohol is so readily available.

The increasing use of tax-free denatured alcohol

will be the logical extension of the alcohol industry in the future. If the spirit of the Eighteenth Amendment is to obtain indefinitely, it will be necessary for our manufacturing interests to secure their supplies of alcohol without being subjected to the shackles that envelop the dealing in alcoholic beverages. As long as pure alcohol for industrial purposes has to pay the same high excise duties as do alcoholic liquids of the beverage class, the same elaborate system of control that applies to the latter will affect the former. The handling of specially denatured alcohol, while subject to restrictive measures, is not manacled by the oppressive restrictions that apply to the tax-paid article.

Denatured alcohol is now extensively employed in the medicine industry. Special formula Number 1, which consists of 10 parts of pure methyl alcohol and 100 parts of ethyl alcohol, is permitted for making solid extracts of vegetable drugs and substances such as podophyllin, scammony, and jalap resins. No alcohol remains in these products when the manufacturing process is over.

Tax-free alcohol, denatured with acetone and petroleum naphtha, may be used in the preparation of santonin, strychnin, and monobromated camphor. Here, again, neither the alcohol nor the denaturants remain when the chemicals themselves are finally ready for the market.

As examples of certain formulas of denatured alcohol that are allowed for making preparations where neither the alcohol nor the denaturants are subsequently removed, we may cite Number 23, containing

acetone and benzol, for external liniments; Number 27, with camphor and oil of rosemary, for the same type of remedies; Number 37, made up with eucalyptol, thymol, and menthol, for external antiseptic liquids, mouth washes, and gargles; and Number 39, with quassia, sodium salicylate, and acetone, for hair tonics and similar tonsorial mixtures used by the trade in barbers' supplies. In all of these formulas the ingredients used are relatively innocuous, at least no more so than the alcohol itself, but are so distasteful that the alcohol could not be diluted to potable strength and used for beverage purposes.[3]

The liberal policy adopted by the officials charged with the administration of Title Two of the Volstead Act, relating to tax-free alcohol, should be fully appreciated by the manufacturing interests of the country, and receive the sympathy and support of the general public. The non-scientist should banish from his thoughts the horror arising when the words "denatured alcohol" are mentioned. He should understand that there is a difference between alcohol that is completely denatured for general use and that which

[3] Very recently a variety of alcohol known as isopropyl alcohol has become an article of commerce, and is functioning to a limited extent in certain formulas of specially denatured alcohol. Knowledge that this is being done has occasioned the circulation of sensational reports that fatalities due to the imbibing of denatured alcohol are caused by the isopropyl alcohol. It can be stated, however, that there is no evidence that isopropyl alcohol has any greater toxicity than ethyl alcohol. Physiological experiments carried out during the past year (1921) on the substance have shown it to possess intoxicating properties equalling, if not surpassing those of ethyl alcohol, but it appears to produce permanent manifestations, neither greater in kind nor degree than are produced under the same conditions by pure grain spirit.

is specially denatured for the industries. As time goes on, most of our familiar household necessities, hair tonics, shampoos, mouth washes, dentifrices, liniments, and probably our favorite medicines, will be made with specially denatured alcohol. The ingredients now used for denaturants are in general those substances that are known to be essential components of the finished preparations. Thus they serve the purpose of rendering the indispensable solvent unfit to drink, they satisfy the legal aspects of the tax-free features of the situation, and they add nothing that will detract from the value of the article.

While discussing the subject of alcohol, it is in order to devote a few words to fusel oil, both because of the popular interest in the substance and its economic status. Nearly every one looks at it askance, as he views wood alcohol. It is the ogre of the whisky-drinkers, especially in these days when there is so much doubt about the nativity and custodianship of our potable spirits.

In referring to the methods by which pure alcohol is obtained, it was noted that fusel oil is formed during the fermentation of the saccharine mixtures at the same time that the alcohol springs into being. It comes over with the alcohol in the process of distillation, to be removed subsequently in the purification-chambers. It consists chiefly of alcohols of higher molecule weight than ethyl alcohol, amyl alcohol predominating. It is the basic substance used in preparing some of the delightful artificial flavors and perfumes. These compounds are called esters. They are prepared by combining the amyl alcohol with an

acid in the presence of strong sulphuric acid. The esters vaporize with great ease and are distilled off and purified. Amyl nitrite, another of these esters, is a limpid yellow liquid that has a marked stimulating action on the heart when inhaled. It is used to relieve faintness, sudden attacks of vertigo, and sunstroke, being featured in little glass pearls, which can be crushed in the handkerchief and applied to the nostrils at the onset of the attack.

The significance of fusel oil as a component of whisky is understood by scarcely one person in a thousand. It seems to be the prevailing opinion that, in order to be safe to drink, whisky should contain none of it. Yet in truth a specimen of delicious whisky, aged six or seven years in the wood, contains much more fusel oil than one that is freshly distilled. The whole question of what happens to pure whisky from the time it is distilled until it has aged for eight years was ably demonstrated in an elaborate investigation undertaken by Dr. Charles A. Crampton when he was in charge of the chemical laboratory of the Bureau of Internal Revenue. The importance of the discoveries made in the course of this research merit careful consideration.[4] It was shown conclusively that when pure rye or Bourbon is stored in the customary charred barrels the fusel oil content gradually increases from year to year. There is actually no more fusel oil generated during the aging period, but some of the water and alcohol making up the bulk of the whisky gradually evaporates through the pores of the wood, reducing the volume in the barrel, while the

[4] *Journal* of the American Chemical Society, 1908, vol. 30, p. 98.

fusel oil does not disappear in like manner. Hence it increases relatively to the decrease in volume of the bulk of the contents.

Freshly distilled whisky is disagreeable to the palate and produces unpleasant conditions in the stomach, not because of the fusel oil, but doubtless on account of some of the volatile constituents, one of these being an aldehyde called furfurol, which in time react with acids extracted from the charred barrel to form an acid ester equilibrium characterizing the mellowness of good whisky. The improvement in flavor is also due to concentration, and the oily appearance of a matured whisky is due to materials extracted from the charred package. This feature is almost lacking in whiskies aged in uncharred wood.

Fermentation and distillation are two arts that have been practised since remote antiquity. The former, of course, preceded the latter. H. G. Wells[5] concludes that Neolithic man in Europe ten thousand years ago possessed no yeast, since the remains of the ancient lake-dwellers in Switzerland show that the bread was exceedingly solid and heavy, and made in the form of round flat slabs. He concludes that if they had no yeast they had no fermented drink. It is more probable, however, that a knowledge of fermented drinks preceded the application of yeast to the leavening of bread, though it is also equally probable that for a long period the reason why milk and fruit juices changed on standing into highly delectable beverages was not appreciated. If knowledge of the subject was possessed by the civilization of the far East at

[5] "Outline of History," Vol. I, p. 113.

that period, there are at present no records available; but drawings of ancient forms of stills dating back to over 2000 B. C. show that distillation was an accomplishment of the populations of India, China, and Egypt. Hence it is reasonable to conclude that some time in the dim past, perhaps five thousand or more years ago, it was discovered that when milk or juices of fruits and berries were set aside for a few days, they mysteriously acquired amazing properties of an exhilarating and highly stimulating nature. Possibly kumiss, a fermented product made from mare's milk, and kefir, a beverage of the same nature derived from cow's milk, the former associated with the peoples of the steppes of southwestern Siberia, and the latter with the mountaineers of the Caucasus, may trace their histories back to Neolithic days. The application of yeast for bread-making was known to the ancient Egyptians. It is not unlikely that the early brews and vintages were accompanied by a great many failures due to the fact that other organisms besides yeast will set up an active fermentation in the same environment, and in modern practice one of the chief concerns of the brewer is the prevention of the access of these other active agents to the material that is being fermented. In those days the nature of fermentation could have been but imperfectly appreciated.

There are many varieties of yeast that do not produce a simple alcoholic fermentation, and their spores are constantly borne about by the air currents, ready to drop into mediums favorable to their development. If they find a resting-place in an unprotected mixture undergoing alcoholic fermentation, they may change

the course of the process, yielding perhaps a product of an entirely different character from that which is contemplated. Up to the time when it became the custom to bring about the fermentation of grape juice with pure cultures of wine yeast, after destroying the other organisms normally present in the must, the pressings from the grapes were allowed to ferment through the influence of the alcohol-producing yeast normally present in the skins. If conditions were right, the proper kind of fermentation ran its customary course and a good wine resulted. Grape-skins are an abiding-place for all kinds of bacteria, including *Mycoderma aceti,* the vinegar-producing organism. They find their way into the juice along with the yeast-cells, and, as all of them are in a medium favorable to their growth, a battle royal results, each endeavoring to sustain itself and produce its by-products at the expense of the others. If the yeast triumphs, the influence of the others is not felt and good wine results.

Pasteur solved the mysteries of fermentation. His researches, with those of Hansen,—who, delving into the biology of the different species of yeast, evolved a method for obtaining pure cultures of these organisms,—have been responsible for placing the industry on its present basis.

Yeasts are fungi of the family known as *Saccharomycetes.* The species producing beer fermentation, and therefore alcohol from wort from starchy grains, is the *Saccharomyces cerevisiæ.*

Wine fermentation is brought about by *Saccharomyces ellipsoides.* In the modern brewery, winery, and

alcohol plant the seed-yeast for producing fermentation is carefully handled and protected from contamination by deleterious foreign organisms. An infection with *Mycoderma* might, as fast as it is produced, change the alcohol to acetic acid, resulting in a vat full of vinegar instead of beer or wine. Wild yeast might act in such a way as to produce substances of peculiar flavor and odor, highly objectionable in character.

In the course of the fermentation the yeast in the wort or must[6] produces more of its kind, and at the conclusion of the process it is of no further use. In plants where distilled liquors and pure alcohol are being produced, the yeast from the wort is recovered and diverted to the baking industry. Compressed yeast is a product of the distilleries where malt and raw grain are fermented. Little, if any, commercial compressed yeast is made from beer-wort yeast. The raw yeast coming from the wort is mixed with starch, and pressed in bags in hydraulic presses, after which it is cut into cakes, wrapped in tinfoil, and kept in cold-storage until ready for use.

Within the last ten years the application of yeast to vitamine therapy has assumed great importance. In a subsequent chapter we shall learn that yeast is the cheapest and most available source of those peculiar principles known as vitamines, and may eventually be relied upon to furnish the ammunition for

[6] The term *wort* refers to the infusion of malt or grain which, after fermentation, becomes beer. *Must* is the unfermented juice as it is pressed from the grape.

combating the dreaded diseases pellagra, beri-beri, and scurvy.

The foregoing discussion emphasizes the vital importance of the alcohol industry. Were it to be suddenly annihilated, the making of medicines and many of the indispensable chemical drugs would come to a standstill, and in a short time the mortality of the population, through inability to obtain medicines, would asssume such proportions that the ravages of the Great Plague of 1665 and the influenza epidemic of 1918 would appear mild in contrast. The baking of wholesome bread is dependent on the ability to produce alcohol cheaply and abundantly. Yeast is the by-product, and we need enormous quantities; otherwise bread, the staff of life, will be lacking in one of its most important life-sustaining qualities. Soda and baking powders cannot replace yeast as leavening agents. They may act as occasional substitutes, but they kill the vitamine, and it is not unlikely that one of the contributing causes to the spread of pellagra in the South is the excessive use of soda-raised bread.

The production of alcohol should be encouraged. Its availability for the legitimate arts and industries should be facilitated by every possible means. Because of its indispensability as a basic material in the manufacture of medicines, it should be relieved of the encumbrances and restrictions now attending its use. Alcoholic beverages have been outlawed, but a spirit of tolerance should be exhibited toward alcohol itself, and its significance as a vital factor in our life and industry comprehended by everyone.

CHAPTER V

FARMING FOR MEDICINE

The native American, in whatever walk of life, has always possessed a liking for tilling the soil and seeing something grow. Our city dwellers, with back yards of a few feet in area, seldom fail to devote a space to raising something, even though the crop consists only of half a dozen tomato plants or a bed of petunias. In the suburbs the operations assume larger proportions, and the modest citizen has his ornamental shrubbery and kitchen-garden in which he delights to spend his leisure hours. On the country estates of the more affluent population the space devoted to agriculture may be quite extensive, and, though the owners themselves may not handle the actual field operations, they possess an active interest in everything that is going on, and take great delight in showing their visitors the triumphs of their professional gardeners.

It is not surprising that references to the production of unusual crops, which began to be featured in the popular literature fifteen or more years ago, and which have continued up to the present, appealed to the non-scientific mind. The subject was a romantic one. The growing scarcity of many plants on which we depended for our medicines was noted, and

soon the interest became universal. Alluring accounts were written of the ease with which this and that plant could be grown in back yards and vacant lots, and lists were published containing the names of a vast number of drugs, those for which there is but little demand being featured equally prominently with the relatively small number that are universal staples. The agitation, however, had its good effects, as we shall see.

You will remember that in the first chapter, under the classification of drugs, reference was made to those derived from the vegetable kingdom, and attention was called to the fact that, while there were many hundreds of these botanicals, only a few might be considered as staples and enjoyed a wide and steady market. These include aconite, belladonna, opium, digitalis, cannabis indica, ipecac, nux vomica, aloes, cinchona bark, rhubarb, senna, gentian, golden-seal, senega, mandrake, bloodroot, arnica, henbane, stramonium, coca-leaves, colchicum, ergot, sarsaparilla, colocynth, cascara, jalap, wild-cherry bark, ginger, licorice, dandelion, and burdock.

When we survey the list of botanical drugs that are in great demand by the druggist and manufacturer of medicines, we find that, while some of them might be cultivated in a country possessing the climate of our United States, nux vomica and cinchona, two of the most important drugs known to medicine, and respectively the sources of strychnin and quinin, are tropical plants, the former coming from India and the latter from South America and Java. Aloes, sarsaparilla, jalap, and ipecac also are natives of hot climates.

Now, as a matter of fact, many drugs grow naturally in our country, and we have always been able to supply our own wants of golden-seal, senega, mandrake, blood-root, cascara, wild-cherry bark, and many others of lesser importance, and also to export them, and, with the exception of golden-seal, the drugs have been gathered from plants growing in the wild state. Most of the so-called pot herbs, caraway, dill, horehound, thyme, tansy, camomile, and calendula (pot marigold), have been grown locally in this country, and gathered usually by the individual consumers; but the bulk supplies used by the drug dealers have been imported from Europe. The same may be said of dandelion and burdock roots, for, while the plants themselves are troublesome weeds, the supplies for medicine-makers have always been gathered abroad. In foreign lands medicinal farming has been in progress for many years. Cinchona plantations are established in Java, and practically all of the bark that finds its way into the avenues of commerce comes from this source. Coca is cultivated in South America; belladonna and digitalis are grown in England and on the Continent; and Belgium has long been noted for its valerian.[1]

Medicine farms in the United States have been in operation for a long time. Years ago the Shakers cultivated and sold large quantities of the common pot herbs mentioned above, and a dealer in crude drugs in Malden, Massachusetts, whose goods enjoyed a rep-

[1] Asoka, an Emperor of India who reigned from B. C. 264 to 228, and who is one of the most remarkable characters in the world's history, was a patron of drug cultivation. Among his edicts have been found those providing for the planting of medicinal herbs and shade-trees.

Harris & Ewing, Washington, D. C.

RODNEY H. TRUE

Father of Systematic Drug Growing in the Country

Edmonston, Washington, D. C.

W. W. STOCKBERGER

EXPERIMENTAL GARDEN ON A MODERN DRUG FARM

LARGE-SCALE PEPPERMINT CULTIVATION

PEPPERMINT OIL DISTILLERY

utation throughout New England, conducted an extensive enterprise. His farms are still producing factors in the trade. A few manufacturers of proprietary remedies have grown their own drugs, notably one in Springfield, Massachusetts, who used large quantities of wormwood and calendula in the preparation of a popular embrocation, and another in Minnesota who produced the stramonium, or jimson-weed, that was an essential constituent of his asthma cure. At a somewhat later date two of our largest producers of medicine for the druggist and doctor embarked in the growing of some of their own crude drugs, such as belladonna, digitalis, and cannabis; and one of them, located in Philadelphia, still maintains an extensive growing acreage, while one of the largest firms manufacturing surgical supplies began to grow belladonna for use in making belladonna plasters as far back as 1904.

Ginseng has been cultivated on small plantations in New York, Michigan, Ohio, and Indiana in increasing quantities since the early eighties, due to gradual extermination of the wild plants, which were collected by woodsmen and trappers to supply the export trade with China. The growers of ginseng have extended their operations to the production of golden-seal, the *Hydrastis canadensis* of the botanist, and now the bulk of the supplies of both of these drugs are cultivated.

This is an outline of the drug-growing activities in the United States down to about 1900. After this a systematic survey of our native drug resources was undertaken by the Department of Agriculture. The

object was twofold,—the development of the cultivation of some of our native drugs that were fast disappearing in the wild state, and the introduction of foreign species for which there was a universal need and which gave promise of being successfully grown under climatic conditions obtaining in the Northern hemisphere.

This work was placed in the hands of Dr. Rodney H. True, an able botanist, to whom, with his co-worker, Dr. W. W. Stockberger, tribute is due for their enthusiasm and untiring labor in studying and directing the development of the problems incident to the new subject. They and their field agents are the pioneers of systematic drug-farming. They gathered in and studied the information concerning the experiences of haphazard investigators, sifted out the chaff from the wheat (and the chaff predominated), dispelled the sentimental ideas of those who were confidently anticipating the making of fortunes in back-yard gardens, and disseminated through publications and personal correspondence reliable data on what actually could be done and how it might be accomplished.

The department established experimental farms in different parts of the country in order to work out the cultural conditions necessary for those of our native plants that were approaching extinction in the wild state, and for foreign drugs that might survive in our climate and for which market conditions indicated commercial possibilities. Experiments were carried out in growing our native drugs, such as golden-seal, ginseng, senega, pink-root, and cascara sagrada, and with such foreign varieties as belladonna, henbane,

digitalis, cannabis indica, aconite, gentian, capsicum, camphor-laurel, etc.

The investigations led to the establishment in Florida of an industry for producing camphor, and in the Carolinas for the propagation of the capsicum pepper. Attempts were also made, and with partial success, in South Carolina, for growing tea, both for beverage purposes and for the production of its active alkaloid, caffein, an important and valuable medicinal agent and ingredient of beverages. Cannabis indica was found to take kindly to the soils and temperature of the Middle Eastern and upper Southern States, and farms for its production were established in Pennsylvania, Virginia, and South Carolina.

The outbreak of the war started a craze for drug-growing that was widespread, and at the time of the armistice there were several concerns and individuals, representing an investment of perhaps a million dollars, engaged in producing belladonna, digitalis, cannabis, valerian, sage, henbane, and stramonium in commercial quantities, and of a grade far superior to anything that had formerly been imported. With the exception of valerian, the output was sufficient to take care of this country's annual requirements; and in 1918 there was an over-production of belladonna, so much so that the crop had not been entirely absorbed before the armistice came, and the subsequent unrest in the commercial world, together with the imminence of renewed imports from Europe, resulted in almost complete destruction of the business for American growers.

The fate of the belladonna farmer emphasizes a con-

dition that confronts the grower of drugs of any variety. The demand of the medicine manufacturer for his staple drugs, though apparently large, is nothing like the demand of the public for such food commodities as wheat, corn, and potatoes, and, while thousands of acres are required to furnish supplies of the latter, sufficient belladonna for our entire consumption can be produced on perhaps two hundred and fifty acres at most. Areas of considerably less extent would take care of our needs of cannabis indica and digitalis, even though both of these commodities are indispensable and in regular use by the practitioner of medicine.

The danger of over-production is one of the important economic factors that will militate against the maintenance of a healthy and successful drug-raising industry in the United States unless it is carefully conducted, as the following illustration will show. For a considerable period there has been coming out of Carroll County, Maryland, an essential oil, called oil of American wormseed, which is obtained by passing steam through the tops of a coarse weed commonly known as Jerusalem oak, condensing the liquid and separating the oil, which floats on the top of the water. The oil is employed as one of the ingredients of some of the favorite children's remedies. The plant grows wild, in waste places, throughout the eastern and southern parts of the United States. It is a troublesome weed in cultivated lands, resembling in appearance, to some degree, the common ragweed. It is cultivated for oil purposes, and, as the industry is closely controlled, the business is profitable, but any

increase in production would result in an over-stocked market.

Passing on to a few general remarks concerning the cultivation of drugs, it should be emphasized that the problems incident to this work are not less difficult than those encountered in the production of other crops. Their growing requires the same outlay for equipment and labor, and additional investment for drying-sheds and laboratory control. There is no romance about the proposition. The growing plants require just as much care and attention as the ordinary truck crops, and often more. A field of belladonna or sage cannot be planted and then left to take care of itself, any more than can a field of potatoes or cabbage. It is a mistaken notion that all one has to do to raise drugs is to plant the seed in the spring, and come back in the fall and gather in the crop of leaves and roots.

In general, the field equipment and the labor force of a drug farm are the same as that required for any kind of agricultural enterprise, and the operations of plowing, cultivating, and hoeing are the same. But the similarity ends there, because a knowledge of the peculiarities of the individual species under cultivation, the character of the soil to which it is adapted, and the cultural conditions necessary to its progress are essential before one can feel any assurance of a successful outcome. It is not an undertaking that can be embarked upon by the average farmer, who is familiar only with the cultural and marketing conditions obtaining with field crops. Nor, except as a pastime, does it hold out any inducement to the small

grower with a back-yard garden or a vacant city lot. The conclusions derived from the experiences of those who have been in close touch with the problem, and from the reports of actual operations, are ably summarized by Dr. Stockberger in a recent bulletin issued by the Department of Agriculture, in which he states that "the production of drugs of high quality requires skilled management, experience in special methods of plant culture, acquaintance with trade requirements, and a knowledge of the influence of time of collection and manner of preparation of the constituents of the drug that determine its value. Small quantities of drugs produced without regard to these conditions are apt to be poor in quality and so unattractive to dealers and manufacturers that the products will not be salable at a price sufficient to make their production profitable. In general, the conditions in this country seem far more favorable to the growing of drug plants as a special industry for well equipped cultivators than as a side crop for general farmers, or those whose chief interest lies in the production of other crops."

The conclusions reached by the economists and experimenters in this country have been echoed by those in Great Britain, for in 1917 the *Pharmaceutical Journal and Pharmacist,* a London publication, contained a report from the National Herb Federation which says in part: "We deprecate equally strongly the propaganda which advocates the indiscriminate and unlimited establishment of herb-gardening associations, with their chain of drying-sheds throughout the country, and the collection and cultivation of small quantities of herbs, which must necessarily be of vary-

ing qualities. . . . The economics of the problem demand concentration, not diffusion. The solution is not to be found in the gardens of the cottage, however much we wish it were so, but in cultivated acres strictly limited in number, and in drying-sheds, etc., thoroughly equipped and conducted on strict business lines.''

In the first place, the number of firms and individuals that work drugs into medicines is comparatively small. The local druggist buys limited quantities of drugs, and his supplies are always obtained from the wholesale dealer, who in turn buys directly from the manufacturer, the importer, or the crude-drug dealer. The cultivator of drugs must find his market with the crude-drug dealer or the manufacturer; and, as these factors have been in the business for many years and are familiar with all conditions of supply and demand, the cultivator is practically at their mercy, both as to absorbing the crop produced and as to the price obtained. So, before one can attempt to cultivate drugs, it is essential to determine the species for which there is always a healthy demand and which can be sold at a price that will pay for the cultural operations. For instance, it would be ridiculous to embark in the cultivation of mandrake, which, though in great demand, grows profusely in the wild state and sells at a price below what it would cost to produce it under cultivation.

Reliable seeds for starting a crop of drug plants are difficult to obtain. Those supplied by the seed houses and listed under ''herbs'' are seldom selected with care, and often as many as 90 per cent. will fail to

germinate. Resort must be had to foreign sources, experimental gardens, and wild plants, and it may be several years before one can safely sacrifice the plants to other than seed purposes.

The cultivation of each species requires special study. The natural habitat of the plant has to be investigated, and artificial conditions made to duplicate those of the locality where the wild plant thrives best. Golden-seal and ginseng must be grown under shade, and in a soil rich with leaf-mold; pink-root requires partial shade and moist, rich earth; belladonna thrives best in a rich soil with sand enough for healthy drainage: in fact, the conditions that are suitable for one drug plant will seldom answer for another.

Very few crops can be sown directly in the field, and some of the more valuable require preliminary propagation in a greenhouse. Others require germination and cultivation for one or two years in specially constructed seed-beds, sometimes with artificial slat shade to prevent damage by direct sunlight during the hot summer months. Transplanting by hand is an arduous task. A crop worth while can scarcely be transplanted to the field without prohibitive labor cost, and resort must be had to expensive machinery specially constructed for this purpose.

The care of the growing plants requires careful study, each species presenting conditions peculiar to itself. Insect pests and diseases, which in the case of staple vegetable crops have been studied and means for their control established, run riot in the drug garden. The coöperation of the entomologist and plant pathologist are essential, and without the aid of these

CULTIVATING GINSENG UNDER SHADE

FIELD OF FIRST-YEAR DIGITALIS PLANTS

A FIELD OF BELLADONNA UNDER CULTIVATION

CURING BELLADONNA

experts the work of the farmer is foredoomed to failure.

In harvesting and curing the ripened crop, the peculiar demands of the consumer must be understood, otherwise the harvest will be valueless. The leaves, roots, herbs, and barks can be successfully prepared for market only in specially constructed drying-houses, maintained at a temperature that will not injure the appearance of the plant nor destroy the delicate active principles.

Perhaps the most important feature in the whole series of operations is the control laboratory, where the drugs are tested to determine their potency and availability for the preparation of medicines; for it is on these features alone that the consumer judges the drug and makes his purchases. Golden-seal and belladonna are bought and sold and made into medicines wholly on the basis of their alkaloidal content, which can be determined only in the chemical laboratory. Cannabis and digitalis must conform to definite standards based on physiological activity. To attempt to dispose of a crop of belladonna or digitalis without knowing its strength would be the height of folly.

Attention should also be called to the shrinkage in weight due to curing, which was the cause of disappointment to the unintelligent grower during the war period. We read in the popular articles of the enormous yields that might be expected per acre, but these figures sometimes referred to the leaves and roots as gathered, and when it was found that a ton of leaf shrank to some three hundred pounds of marketable drug, it can readily be seen how many dreams of gold-

mines from quarter acre plots went glimmering. Certain drugs probably never could be produced in the United States, owing to the character of the operations required to prepare them for the market and the labor costs incident thereto. For instance, saffron, which was formerly widely used in medicine, and which still enjoys a moderate demand both as a drug and a condiment, consists of the orange-colored stigmas of the flowers of a low-growing, fall-blooming, bulbous plant of the iris family, cultivated commercially in southern Europe. The stigmas are removed from the flowers either by pulling or by cutting them off with the fingernail, after which the flowers are thrown away. About fifty thousand flowers are required to produce one pound of dry saffron; hence the amount of hand labor involved in removing enough stigmas is large, and, while it may be done at a profit with the aid of the cheap child and woman labor of southern Europe, it would be out of the question in this country under almost any wage condition that would be acceptable to the farm-hand.

The limits imposed on a work of this kind necessarily preclude a detailed account of the methods employed in the cultivation of the various drugs, but this chapter would be incomplete without a short account of the operations incident to the growing of a few of the important species.

Reference has already been made to the establishment of the camphor industry in Florida. The tree yielding this universal remedy is a large evergreen native to Asia, and is easily grown from seed that is planted in large beds by means of a planting device

similar to that used for setting out cotton. The young shoots begin to appear in about three months, and after the plant can be distinguished from the naturally occurring weeds and grass, the bed is cleaned out with hoes and cultivators. After remaining for a year in the seed-bed, which may be an acre or so in extent, the young trees are transplanted to their permanent location. For the next two or three years the soil is kept in condition by cultivation and hoeing, and if conditions are right the trees should be from seven to eight feet high. Then the ends of the branches are clipped just as a hedge is trimmed, a special machine being employed for the purpose. The trimming is done when the trees are in the dormant stage, which is twice each year, usually from November to January and from May to June.

The cuttings are hauled away to a distilling plant, where they are packed in large iron drum-shaped retorts connected with spirally curved pipes surrounded by cold water, which condenses the steam driven by pressure through the mass of twigs. The mixture of water and camphor oil running out of the tap at the end of the spiral pipe is separated. Much crude camphor in crystalline form separates out of the oil, and the latter is drained off or separated by a centrifugal machine which throws off the excess of oil and water and leaves behind a mass of camphor crystals.

Camphor imports into the United States usually exceed three million pounds annually, so that the prospect of an over-production would not appear imminent. However, sad to relate, the Florida camphor industry is now virtually at a standstill, and

one of the largest operators has dismantled his plant and abandoned his plantation. The influx of camphor artificially made from turpentine was one of the causes; and the general slump in the industrial world and the difficulty of competing with the cheaper labor of Japan have added to the difficulties of the situation.

The industry devoted to the production of the oils of peppermint and spearmint is similar to that of camphor in so far as the distilling operations are concerned; but, while the camphor-laurel does not fare well in a climate that shows a temperature lower than fifteen degrees above zero in winter, the mints do not thrive in the hot climate of the South, preferring the cooler regions, and also the dark humous muck soils of the North; hence the growing of the plants and distilling of the oil have centered in Michigan, New York, and Indiana. The mint farms of New York State were at one time extensive and profitable, but this industry shifted to Michigan, where at the present writing a firm, with headquarters at Kalamazoo, virtually dominates the growing of peppermint and spearmint, and to a large extent the distillation and refining of their oils. The drug trade consumes a certain quantity of the dried herbs annually, but by far the major portion grown is used in the production of oil.

The farms occupy hundreds of acres, and their operations are conducted with all the labor-saving devices and attention to scientific cultural operations that the modern farmer can acquire. The firm also acts as a clearing-house, so to speak, for the small growers scattered throughout that section, receiving their crude oils, refining them by modern methods,

and thereby saving them the heavy overhead expenses that in the case of a small enterprise would render the operations unprofitable.

Most of the peppermint oil goes to the flavoring manufacturers, and the spearmint is chiefly taken by the proprietor of a popular brand of chewing gum. The annual production of the former is close to three hundred thousand pounds, and of the latter about fifty thousand pounds.

A field of either of the mints is propagated from runners or sections of roots. The plants grow rapidly, and the field is kept free from weeds, since their presence in the harvested crop would seriously injure the quality of the oil. The herb is cut in July or August, at which time a mint farm takes on the appearance of an enormous hay-field, with the mowing-machines, rakes, and tedders busy getting the crop in shape for the stills. When the herb is fairly well dried, it is placed in large stills of similar construction to those used in distilling camphor oil. These stills are often made of wood and may be very crude, but the modern stills are of the latest approved mechanical design and may have a capacity of three tons of dried herb.

The firm that worked out the scientific production of mint in Michigan is the only one in this country that has been able to grow henbane successfully in commercial quantities. This drug is in steady demand, though its annual consumption is not so great as is that of belladonna; but, since it was a product of the Central Empires and Russia, the importations were shut off soon after the beginning of hostilities in 1914. Henbane grows wild in Montana and the Northwest, but

the quality of the leaf is poor, and attempts were made to reduce it to cultivation. The plant belongs to the same family as the potato, and those who attempted to grow it soon found that all the potato-beetles in their vicinity left their former happy hunting-grounds and swarmed into the henbane field, where they wrought havoc in the growing crop. Spraying with arsenicals served to keep the pests in check, but, after a shower had washed off the insecticide, fresh relays returned and took their toll before another application from the spraying-machine could be made. The difficulty was surmounted by hand-picking the bugs, and this practice was kept up daily until the generation in existence at the period had passed on.

The growing of belladonna for commercial purposes began about 1904, when F. B. Kilmer of New Brunswick, New Jersey, set out about fifteen acres of the plants. The crop was all consumed by the well known firm of Johnson and Johnson, with which Mr. Kilmer was associated, for making belladonna plasters. These plantings have extended and are in operation to this day. The interest in the possibilities of this crop increased in the years preceding the war, and after the opening of hostilities, when the price of the drug began to soar, farms were established in Virginia, Pennsylvania, Indiana, Michigan, and California. As has already been noted, the wholesale production led to an over-supply, about eighty-three tons being produced. The bottom dropped out of the market in 1918, and most of the growers have abandoned their efforts.

Both the leaf and the root are used in making medicine, but the latter can be harvested with profit only

after several seasons of growth. The first plantings are made from seedlings, which have to be started in a greenhouse or hot-bed, because it has been found impossible to obtain a crop from seeds sown directly in the field. After a vigorous root system has been established, the young plants are set out in the field by means of a tobacco-planter, a machine operated by three men and a pair of horses. Cultivation and hoeing are essential to give the plants an opportunity to get ahead of the weeds, and when flowering time arrives, the tops and leaves are cut by hand and immediately transferred to a drying-shed and cured by artificial heat. If the season is propitious, three pickings can be made the first year, and then the roots are mulched over the winter, or dug and stored in a cold cellar or pit, the same as are potatoes. The following spring the roots can be divided and set out, and the acreage gradually increased both by this means and by new seedlings.

Belladonna has been grown by manufacturing medicine houses in Indianapolis and Philadelphia for use in making their standard pharmaceuticals. The quality of the drug grown in the United States far surpasses anything that ever came from Europe. The alkaloidal content, on which its medicinal value is based, has been brought up to seven tenths of one per cent., and even, in some cases, to one per cent., of atropin, while the imported article seldom goes higher than four tenths of one per cent.

The strain producing the highest potency was developed by Dr. Stockberger in the course of his experimental work on the government farm at Arlington,

Virginia. This strain was adopted by some of the successful growers during the war, and the exceptional quality of the leaf received favorable comment from the crude-drug merchants and medicine-makers who were fortunate enough to obtain it for their trade.

Digitalis, one of the most important drugs to the therapeutist, has been grown under carefully supervised conditions in Virginia and Minnesota, and plantings are reported from Pennsylvania, South Carolina, California, and Washington. The Virginia leaf has attained the greatest reputation, owing to its superior and uniform potency, and its reliability when converted into standard medicinal tinctures. Digitalis preparations are used for diseases of the heart, and when the physician is called upon to use them there must be no doubt about their action, because the question of life and death may depend on the action of the four or ten minims administered. Dr. Hatcher, of the Staff at Bellevue Hospital, New York, developed a special tincture from the Virginia leaf which served him in good stead on many critical occasions. Since then the fame of the drug has spread all over the East, until several of the larger hospitals have specified its use for their dispensaries.

Digitalis is propagated from seedlings in much the same way as is belladonna, and its planting in the field and subsequent cultural care are identical. The plant is a biennial and ordinarily does not produce flowers the first year. It develops a remarkable leaf system, however, which is cut off as fast as the growth matures, and the harvesting is usually continuous until frost. The leaves of best appearance in the trade are

usually washed to remove the particles of soil that adhere to the tiny hairs, and then immediately dried by artificial heat to prevent fermentation, which sets up if the leaves remain in the moist state, and which causes destruction of the delicate active principles on which the medicinal value depends.

Any one who was fortunate enough to have had a grandfather with a cottage in a country village will recall that there was always a place in the garden for a few sage-bushes. You found growing there sage and usually a few other so-called pot herbs, like horehound, catnip, dill, thyme, and tansy. Sage is usually listed among the drugs, but its greatest use is for condimental purposes, and most of it is consumed by the sausage-makers. Its growing in a small way has been conducted here for many years, and the quality of its leaf far surpasses the Austrian and Greek sage in delicacy of flavor and aroma, but the imported article is really the chief factor in the trade, and is annually brought in to the amount of hundreds of thousands of pounds. American sage has been discriminated against by the government in its supervision of the packing industry, because, for some reason or other peculiar to its metabolism, it absorbs more mineral matter from the soil and therefore shows a higher ash content than do the Austrian and Greek products on which the standards for ash determination have been drawn. And, even though the American product is far superior for the purposes for which it is used and may be preferred by individual packers, they are often obliged to refuse a beautiful lot of high-grade domestic leaf because there is more mineral

matter in it than the arbitrary limits set by law, and which, as we have noted, were based on an alien product.

However, in spite of the handicaps with which it is beset, sage of domestic growth finds its way into the trade. A field of sage in full bloom, with its deep purple blossoms, interspersed here and there with an occasional clump of daisies that have escaped the attention of the cultivator, is a sight not soon to be forgotten. It grows easily from seed sown in open beds in early spring, and can be transplanted to the field when vigorous enough to maintain itself. The first year the growth is only moderate; but it winters well, and for several years yields an abundant crop of delicate gray-green aromatic leaves, the odor of which pervades the entire neighborhood when the pickers are at work. The best sage is hand-picked and spread on racks under cover in a well ventilated barn, where it dries rapidly. In two weeks it is dumped, the adhering sand and dirt shaken out of the pile, and the cured leaf baled for shipment. Sage has been grown rather extensively in Virginia and other Southern States and in the North Central States.

No story of drug-farming could be complete without devoting a few words to ginseng. More people are familiar with the name and fame of this drug than they are with any other, and yet it is used to a slight extent only in the medicines made and sold here. The ginseng industry used to be associated with the fur trade, because the trappers, in their rounds through the lonely forest wastes of the North, collected the roots and brought them into the settlements

with their wares. The dried roots have been exported from this country in increasing quantities since the early years of the eighteenth century, and, as the supplies from natural sources became more difficult to procure, the cultivation of the plant was undertaken, and at the present time a large part of the business is in the domesticated root. Some idea of the volume of the trade and the value of the commodity may be observed when it is seen that in the decade from 1860 to 1869 more than four million pounds were sent out of the country, at a value of nearly fifteen million dollars. From 1910 to 1918 some two million pounds were exported, valued at nearly fifteen million dollars. Nearly all of this is absorbed by the population of Korea and China.

It is an interesting historical fact that the first venture in foreign trade of the new-born Republic of the United States was that of several merchants in New York and Philadelphia, who on Washington's Birthday, 1784, cleared for Canton a ship fittingly named the *Empress of China,* loaded principally with ginseng to barter for teas and other manufactures of the Orient.

Ginseng adapts itself readily to cultivation in New York, Michigan, Indiana, Kentucky, and Ohio, and in all of these States many plantations of a few acres each are maintained. The center of the exporting business is New York City, where several dealers have direct connections with distributors in China.

The seed is usually sown in the late summer or early fall in protected beds, and the seedlings, which appear the following spring, are allowed to grow

until the second year, when the roots are transferred to their permanent location. The beds in which the plants are allowed to mature are carefully located with respect to drainage, and the soil is so treated that it may contain the proper amount of sand and leaf-mold. Artificial shade is provided, unless the plantation is located in the woods, in which case all of the low trees and under-brush are cleared off, and the tall forest timber furnishes the shade that is essential to the life of this species.

If the conditions are favorable, the roots are ready for the harvest about seven years after the seed has been planted. The crop requires attention during its development. Weeds must be kept down, the seed gathered in the fall, provision made against the ravages of weeds, mice and moles, and thievery. In some States the importance of the ginseng industry is recognized in the statutes, which make it a felony to rifle a ginseng garden.

When the root is gathered, it must be carefully cured, and this requires an expert knowledge of the peculiar requirements of the trade. It is easy to spoil the crop at the end of the long seven years of waiting. Roots that are good and sound when gathered may be rendered hard and unsightly by improper drying; and, where they might have brought from eight to ten dollars a pound, or even more, if dried so that they will break with a soft and waxy fracture, they may be worth but a small fraction of this amount. The shape of the root often determines its value to the Chinaman, just as an elephant with twenty toes is worth more to an Indian than one with the custom-

CANNABIS DRUG UNDER CULTIVATION

HYDRASTIS CANADENSIS OR GOLDEN SEAL

GINSENG LEAF AND ROOT

ODD-SHAPED GINSENG ROOTS

Courtesy of C. M. Goodspeed

HENBANE SHRUB

AMERICAN WORMSEED TOPS

PLANT OF THE CAPSICUM PEPPER

CULTIVATED HOREHOUND

ary number. Those for which the highest prices are paid resemble in shape the figure of a human being; and the more complete the resemblance is, with the arms and legs and other extremities characteristic of the nude male, the greater the value.

Ginseng has been a source of considerable profit to those who have given its growing the proper attention and care; but, where one has met with success, hundreds have met with disappointment. As a general proposition, the cultivation of ginseng and other slow-growing root drugs, like golden-seal, offers little inducement to any one who is not in a position to devote the necessary time to familiarizing himself with their life histories and the peculiar conditions incident to their propagation, and to wait long years until the first returns can be expected.

The future of the drug-growing industry in this country is problematic. Mint-raising is well established, and has been for many years, and the same may be said of plantations of ginseng and golden-seal. The United States is looked upon as the original source of these commodities. As the supplies of other species of our indigenous staple drugs, such as senega, pink-root, aletris, cascara, and serpentaria, begin to dwindle, it will be necessary for some one to undertake their cultivation, and the study of their growth and habits under artificial conditions is now being worked out at the experimental farms of the Department of Agriculture.

In the case of the exotic drugs, the fate of the industry in their production will depend upon whether the American medicine-man is willing to pay a reason-

able price for his supplies with the guaranty of a drug of high quality, or whether he will prefer the less expensive imported stuff, even when of inferior grade. Our producers of exotic drugs cannot compete with the labor conditions abroad, and it is probable that, unless such drugs as belladonna, digitalis, and sage receive the protection of a moderate import duty, the business of supplying them will return entirely to foreign dealers.

CHAPTER VI

PATENT MEDICINES: THEIR PLACE IN THE ECONOMY OF THE NATION

We discussed in the second chapter the relationship existing between the several factors of the drug trade, and showed how the activities of one group merged with the activities of another. The position occupied by the industry engaged in the production of patent or proprietary medicines was noted, and it has been deemed expedient to devote a separate chapter to emphasize the place that these remedies occupy in the field of medicine and in the economy of the nation. Some of these preparations are in universal use in the households of our population, and have become, so to speak, national institutions.

The term "patent" medicine is a misnomer, for very few of these medicines have been granted protection by means of letters patent. Many of their names have been copyrighted and the characteristic script trademarked. Some of them have been made and sold for so many years, and have become so well known, that altogether the owners have a proprietary right to the names and formulas of the preparations. "Proprietary" is a more appropriate designation, and these products are usually spoken of as proprietary remedies.

When proprietary medicines first began to appear on the market, patents were granted giving exclusive right to formulas sold under distinctive names, but this practice has long since ceased. An example of a popular remedy that until recently enjoyed patent protection, both for its manufacture and name, is that of aspirin. This substance is a chemical individual, not a formula made up of several different drugs in admixture. It was evolved and patented by a German firm. Since its introduction it has been sold directly to the public. Patent rights are effective for seventeen years, and the protection thus accorded to aspirin expired a year or two ago. Copyright protection to a name, a device, or an insignia is perpetual, and there is still some controversy over the exclusive right to the name, because the word "aspirin" is in some respects distinctive. The chemical name of the product is acetylsalicylic acid.

This explanation has been made in order to show what actually constitutes a "patent" medicine, though, strictly speaking, it should be called a "patented" medicine.

Proprietary medicines are those medicines with which the general public is most intimately acquainted. Attention is called to them by advertisements in the daily press. Some one and often several of them occupy prominent places on the shelves of the family medicine-chest. There is hardly any one of us who does not depend on some favorite cough syrup, liver pill, rheumatism relief, or headache cure when occasion calls for its use, and we take pleasure in

recommending it to an ailing friend who may not have been cognizant of its virtues.

The character of these preparations has always been a matter of considerable interest, but the only information on the subject, outside of that contained in the printed circulars accompanying the medicines themselves, has been that dispensed to the public in sensational magazine articles appearing from time to time, and that are more or less erroneous and misleading. It has been claimed that advertising in the lay press has been responsible for their continued existence, that to this alone is due the success that they enjoy. It is true that, without this means of keeping before the public the facts of their existence, the business would languish; but the popularity of any individual proprietary remedy is due to other fundamental reasons.

In the drug trade, and especially among the retailers who are the actual dispensers of these medicines, there is a great deal of ignorance respecting their composition and character. In fact, it may be said that, outside of the manufacturers themselves, those who are best acquainted with what proprietary medicines are, and what they will do, are the people who use them.

It matters not how many sensational articles may appear decrying the practise of placing in the hands of the public medicines that consist chiefly of alcohol, water, and coloring matter, or brilliantly colored pills and tablets that cost but a trifle to make, or disguised dope, or other nonsense of like character, the

mountaineer's wife in her lonely cabin, miles from the family doctor or the general store, keeps among her meager supplies her favorite remedies, which have rarely failed her in time of need; and, as has already been noted, most of us keep a supply of some headache mixture, cough syrup, laxative pill, or tonic to use in an emergency. After we have become acquainted with them we use them because they yield the results we are seeking, and not because of the fact that their existence is kept before us by the advertising columns.

The situation is ably summarized in the words of W. H. Cousins, a prominent retail druggist and pharmaceutical editor, who, in replying to a questionnaire of the Commission on Proprietary Medicines of the American Pharmaceutical Association, said: "I have found that most people who buy medicines for self-medication do so because the remedy has given relief on former occasions. I feel safe in saying that ninety per cent. of the buyers of proprietary remedies do not know what they contain, neither do they care. The sale of a proprietary depends on the effect it has on the ailment for which it is recommended, and not on what it contains." [1]

Not long ago a remedy for whooping-cough was before the courts for review, and the prosecutor was endeavoring to show that there was no direct cure for the conditions that the claims on the package indicated the preparation was intended to relieve. Professional evidence was introduced tending to show that the product was of such a nature that no relief could be

[1] Journal of the American Pharmaceutical Association, 1910; p. 1384.

obtained from its use, and that the treatment of the disease should follow a certain approved course entirely different in character. The defense introduced the evidence of a number of practical children's nurses and mothers who knew little about diagnosis as it is recognized by the trained physician, but they all knew children and all knew when children had whooping-cough. One and all testified that when they had administered the medicine in question the children stopped whooping. The court was satisfied that, no matter if medical theory tended to show that the treatment of whooping-cough should follow an entirely different course than that which was contemplated by the use of this remedy, the results obtained by those who had tried it showed that it contained something in its makeup which did stop the children's whooping. That was what the mother wanted, and that was what the remedy claimed to do.

The above narrative is cited as an example to show why some popular remedies have acquired their reputation. Their best advertisers are really their satisfied patrons.

Up to fifteen years ago the descriptive matter on the labels and packages of proprietary remedies contained much that was objectionable, and in many instances the claims were absolutely false. Many of the remedies themselves were of doubtful character. Certain classes were unquestionably a menace to the public. But all medicines advertised directly to the public were looked upon as being in the same family. The good ones were not distinguished from the bad. The passage of the National Food and Drugs Act, popularly

known as the "Pure Food Law," and the enactment of similar legislation in many of the States, opened up an entirely new era in the history of proprietary medicines. Shortly thereafter those products that were purely fictitious in character and purpose began to disappear, and there has been a gradual weeding out of those that were objectionable either in their composition or for the purposes for which they were intended. Firms whose medicines possessed meritorious properties, and which were objectionable only because of mistaken methods of labeling, largely due to the conditions that prevailed in the industry prior to 1907, revised their circulars to meet the new order. Those remedies that have survived are actually in a stronger position to-day than they were before the inauguration of the remedial legislation.

A tribute should be paid to Dr. Harvey W. Wiley for his aggressive work in administering the law in the early years of its operation, and his uncompromising attitude toward unworthy preparations. Those manufacturers who now enjoy the protection of the law, and whose products are being used because they possess signal merit, owe him a debt of gratitude, though perhaps Dr. Wiley might not appreciate the testimonial.

There is a fallacious belief that some proprietary remedies furnish the means whereby the "dope" habit is acquired. But if one will refer to the requirements imposed by the Proprietary Association itself on its members, and which are quoted in a subsequent paragraph, it will be noted that the use of such habit-form-

ing drugs as opium, morphin, codein, and other derivatives of opium, is permitted only under very restricted conditions, and in relatively small dosage. The use of cocain is not allowed. Some time previous to the enactment of the Food and Drug Law and the Harrison Anti-Narcotic Law, there were several treatments for the morphin and opium habit advertised and sold directly to the public, nearly all of which contained morphin and opium; and, as anyone could buy them, they furnished a ready medium for obtaining the drugs. Furthermore, there were several brands of catarrh snuff on the market that contained morphin. Cocain was sold in large quantities as an ingredient of certain popular asthma cures. The remedial legislation cited above has stopped the traffic in all of these products.

But by far the greater number of unfortunate victims of the use of cocain and the opiates have not acquired the habit through the classes of medicine just mentioned, which were available to all before the Harrison Act went into effect. They became addicts as a result of treatment by the medical profession for some condition requiring the use of narcotics, or by association with other addicts.

Acetanilid, phenacetin, and aspirin are not "dope," and if properly used should cause no untoward effects. They are not habit-forming in the sense that those who take preparations containing them become addicts. They are employed to relieve pain, and hence have functioned extensively as ingredients of headache mixtures and neuralgia cures. While over-indulgence in

such preparations is not commendable, it does not merit the same concern as does the habitual use of the opiates and cocain.

After the house-cleaning incident to the administration of the Pure Food Law and the readjustment that naturally followed, the trade in the old-line proprietaries steered a straight and comparatively unruffled course until the advent of national prohibition. Then, when the business of manufacturing and dealing in intoxicating liquors became outlawed, a number of firms that had heretofore been engaged in the liquor business embarked in the compounding of medicines and flooded the country with quantities of preparations that were simply camouflaged liquors. One of the mistaken popular notions is that liquid proprietary medicines are composed chiefly of alcohol, and that any beneficial effects derived from them are due to this stimulant. The actual facts are that the old-line liquid remedies contained no more alcohol than is necessary to keep the medicinal agents in solution and prevent spoilage from bacteria and molds. However, the liquor trade apparently did not know this, and, as their new products were advertised extensively and soon became generally known and talked about, the idea that liquid proprietary medicines owed their virtues to alcohol became more deeply rooted than ever, and for a time was a cause of great concern. The consumption of alcohol, which had been running along at a normal average for the entire medicine trade of the country, suddenly jumped to several times the customary volume, the increase being due to the introduction of the new element in the trade.

This condition nearly brought the entire medicine industry into discredit; but, fortunately, there were sane men at the head of the administrative forces in Washington. They knew what was legitimate and what was not, and again the weeding-out process began and again the meritorious remedies came forth unscathed. It is an interesting fact that, of the thousands of bona-fide complaints received by the Prohibition Unit, not one involved a legitimate proprietary remedy that had been firmly established before the Volstead Act was passed.

As a matter of fact, at the time the Volstead Act went into effect, and for some time previously, there were no legitimate proprietary remedies that were capable of being imbibed for the satisfaction that might have been gained because of the alcohol. They contained medication of one kind or another, depending on the conditions they were intended to relieve, in sufficient quantity to produce a therapeutic reaction in relatively small doses. It is admitted that there were on the market at that time a large number of alcoholic medicinal bitters, tonics, and the like, labeled in a way that suggested that they were medicines; but for many years the Bureau of Internal Revenue had been classifying as beverages products containing less than an average dose of some recognized remedial agent to the fluid ounce and more alcohol than was necessary for solution and preservation, and compelling their manufacturers to pay the usual liquor tax in order to sell them. By this means the real medicines had been separated from a class of preparations which were the cause of the criticism that had before that time been

made against all proprietaries containing alcohol. This quiet and conscientious work of the laboratory staff of the Bureau of Internal Revenue has never received the credit it deserves. It was doing with little cost what the Prohibition Law is trying to do at an enormous expense.

In 1915 the Proprietary Association of America, embracing some eighty per cent. of the entire trade in bona fide medicines advertised directly to the public, adopted a set of requirements to which all products sold by their membership were obliged to conform. These requirements were based on a report which had been made in 1915 by the American Pharmaceutical Association, the national organization representing all branches of the drug trade and the chemists and educators engaged in pharmaceutical practice.

The requirements for membership and provisions for enforcement of the same are as follows:

(1) The preparation must be of such character as may reasonably be expected to bring about the results for which it is recommended. Statements on packages and elsewhere regarding composition, origin, place of manufacture, and name of manufacturer or distributor must be in exact accordance with the facts. Statements regarding therapeutic effects must neither be obviously unreasonable nor demonstrably false.

(2) The preparation must not be offered or intended directly or indirectly for use as an abortifacient nor for any other immoral or illegal purpose.

(3) The preparation must not contain cocain or eucain[2];

[2] Eucain is an organic chemical prepared synthetically. It is not derived from cocain and bears no resemblance to it in chemical composition. It is an anesthetic, and is used in medicine for producing the same effects that are produced by cocain.

nor shall it contain opium or any of its alkaloids or their derivatives in greater proportions than those specified in Section Six of the federal law commonly known as the Harrison Act, and it shall also contain other active drugs in such proportions that when used as directed it will not be likely to create or satisfy a drug habit; provided that if specially intended for the use of babies or small children the preparation shall contain none of the drugs named in this section in any quantity.[3]

(4) If the preparation contains alcohol, the amount shall not be greater than is properly necessary to hold in solution in permanently active condition the essential constituents of the preparation, and to protect against freezing, fermentation, or other deleterious change, and the medication shall be sufficient to render the preparation unsuitable for use as an intoxicating beverage.

(5) The preparation must not be advertised or recommended as a cure for diseases or conditions which are generally recognized as incurable by the simple administration of drugs.

(6) The package, either as to wrapper, label, or accompanying literature, shall contain no statement in conflict with the misbranding provisions of the Federal Food and Drugs Act.

(7) The preparation must be of such a character as not to endanger life or health if used in accordance with instructions accompanying the package.

(8) In order to secure the enforcement of these requirements and to take charge of the examinations necessary to that end, a Committee on Requirements shall be selected by the Executive Committee, with power to carry out the work as outlined by these requirements, under such rules and with such salaries as may be determined by the Executive Committee, to which Committee may be appealed any find-

[3] Opium, morphine, heroin, codein, cocaïn, alpha and beta eucain.

ings of such Committee on Requirements. For the purpose of rendering all possible aid to the members in the work of conforming their preparations to the requirements, each member shall submit for examination to such Committee on Requirements complete packages of his preparations, including all literature contained in such packages, with such information as may be necessary to determine the fact of compliance in all respects with such requirements. No member shall be obliged, under this provision, tc reveal his formula.

In order to make its policies effective, the Proprietary Association established a permanent Requirements Committee, under the supervision of which all the labels and reading-matter accompanying the packages of medicines sold by its membership were studied and revised in the light of the composition of the remedies and the latest authoritative medical knowledge. Any firm seeking admission to the association is obliged to furnish the committee with a complete set of its labels and literature. Membership is not granted until the recommendations are agreed to. Some of the best technical talent of this country is now associated with the industry. The latest improvements in special apparatus and machinery necessary for the making of medicines have been installed by the individual firms, until now such plants as the Peruna Company, the Swift Specific Company, and the Chattanooga Medicine Company, are among the best equipped of any factories manufacturing medicine in the world.

The association has instituted a series of important researches on the larger problems affecting its business. The studies have included the determination

of possible ways and means of reducing and eliminating the use of alcohol in the preparation of liquid medicines. The results have been so successful that many firms have been able to adjust their formulas and to reduce the alcoholic content of their preparations to less than one half what it formerly was. Researches on the physiological action of individual drugs and their effect in various combinations are in progress, and methods are being worked out for estimating the quantities and proportions of various drugs and chemicals in complex mixtures, where heretofore no well-defined processes have been known.

Individual proprietors are conducting special researches on their own immediate problems, and the results obtained are often of remarkable scientific importance.

On the whole, it may be asserted that the association embracing the old-line and some of the newer legitimate proprietary remedies is to-day the most progressive organization in the whole field of drugs and medicines.

The capital represented by this industry, according to the census taken in 1914, amounted to more than seventy-one millions of dollars, which is about twenty-five millions more than is represented by the industry engaged in manufacturing pharmaceuticals and chemicals for the drug trade.[4]

A large proportion of the firms engaged in the man-

[4] Parallel figures for the industries as shown by the 1919 census are not fully compiled as yet (November, 1921), but the data for Massachusetts shows for the proprietary industry an increase in capital of between 30 and 40 per cent. over 1914, and the conditions in this State are fairly representative for the country at large.

ufacture and distribution of proprietaries are concerned with one main product and perhaps a few others of lesser importance. A few of them put out quite an extensive line of medicines for various purposes; but this is not usual, and those that are thus engaged are concerned with supplying a special class of patrons in the rural and more isolated localities.

The individual legitimate proprietary medicines today are representative of the highest perfection of the art of the pharmacist and chemist, be they offered in the form of pill or tablet, powder or granule, elixir or emulsion, syrup or complex extract. Since each product is made in enormous quantities, the process of manufacture has become standardized, and uniformity in character is assured. Ingredients of the highest quality only are employed. They are selected from the best of the supplies offered by the crude drug and chemical trade, and as the individual items used by a successful firm amount to enormous quantities yearly, competition for the trade is keen.

Proprietary medicines need no excuse for their existence. They have been evolved because there is a public demand for them. They fill a place among the necessities of life that can be filled in no other way. The manufacturing houses supplying the goods used by the retail druggist, in catering to the wants of the doctors of the country, do not advertise their wares directly to the public, and they have all they can do to keep up with the needs of the doctors. The proprietary manufacturers sell their medicines through the drug trade, too, but the demand for them is largely from the public direct, though a large por-

tion of business results from recommendations by doctors. For example, most of us have heard the family physician advise the use of Scott's Emulsion or Pepto-Mangan, or Fellow's Syrup of Hypophosphites for a convalescent from some wasting illness.

One of the main reasons for the existence of proprietary remedies is that the family may have on hand, when occasion calls, a shelf stocked with useful and reliable remedial agents. When the little boy or girl wakes up in the night and chokes out an agonizing cough, there is no time, even in our thickly populated cities, to call the doctor or run to the drug-store; the croup must be relieved immediately by the quick application of some irritant and aromatic salve or embrocation. In the country districts and in the isolated hamlets of the mountains and prairies, where the doctor may be out of call except from a personal messenger, the necessity of having something of this kind within reach is apparent to everyone.

The sudden onset of severe congestion in the chest, or the racking cough that may develop after a day of exposure, demands quick relief from some remedy close at hand. Acute indigestion of the adult from imprudent eating, and the agonizing and intolerable pains of the child resulting from a surreptitious picnic in the apple or peach orchard, requires prompt attention. The onset of an acute attack of rheumatism, so common where living conditions are unfortunately not so sanitary as they should be, is ameliorated by the prompt resort to one of the numerous mixtures that have been evolved for treating these painful symptoms. The necessary local applica-

tion for rheumatism, as well as the pain and soreness resulting from the strains and wrenches of a laborer's calling, must be kept on hand, whether they be Sloan's or Johnson's Anodyne liniment, or some other favorite formula.

Acute headaches must be relieved, boils, carbuncles, and corns mitigated, the onset of a sudden attack of diarrhea checked, poisons by insects and ivy reduced, the mouth and throat washed with an antiseptic, the scalp cleaned of dandruff, and many other simple annoyances to the human system corrected; and for any one or all of them the family medicine-chest must contain its panacea.

Constipation, our national ailment, which is no respecter of persons, be they high or low in the social scale, is catered to by a startling array of laxative pills, tablets, and powders. Every one of us knows the particular product to which his system responds with the greatest satisfaction. It is a truism that if our people were thoughtful about the food they ingested and were particular about the functioning of their alimentary canals, a large proportion of the common ailments, outside of the social diseases, would not occur. But, as relatively few of our people stop to think of the future when they sit down to a meal, and as there seems to be no prospect of educating them to become dietitians during the next fifty years, there will be indigestion and constipation among us, and, as long as there is going to be indigestion and constipation, the people are going to want remedies for them.

In this discussion references have been made to the

dependence of the rural population on family medicines. We pride ourselves on being an agricultural country. We consider our farmers the backbone of the nation. Their farms are everywhere, near our large cities, in the rich valleys of the rivers draining the Alleghanies, by the broad expanses of the sea-coast, in the clearings of the forest-lands of the Northwest, on the flat and sun-baked prairies, and on the slopes and ridges of the mountain-ranges. Their life is such that they and their families are often subjected to periods of strain and overwork, sometimes to conditions of sanitation that are not of the best; they breed more profusely than does the urban population; their women are more prone to suffer the discomforts peculiar to their sex; and accidents with lacerations and liability to infection are common. Many other conditions incident to their environment and mode of life make it essential that they should have at their disposal well tried remedies, permanent in character, properly packed to withstand climatic conditions, the dampness of the sea-coast and river-bottom and the parching heat of the prairie, and which are so uniform in their composition that, given a definite set of symptoms, they can reasonably expect to obtain the same relief from a package bought to-day that they obtained when seeking the same relief from a package purchased a year ago.

Legitimate proprietary remedies, as they are now offered to the public, are in the main products representing the highest type of the pharmacist's art. They are made of ingredients carefully chosen to fulfil the promises of the claims on the label and in the circular.

Those requiring alcohol in their make-up contain no more than is necessary to hold the ingredients in solution and keep the mixture from spoiling. They are not suitable to be used for beverage purposes. They do not contain "dope." The amount of capital invested and the yearly business of the industry is many times greater than that represented by any other group in the drug business. The remedies are universally employed by our entire citizenship, and for certain classes of the population are indispensable, since they furnish the only relief available when sudden illness strikes, and when the isolated householder requires the aid of drugs for general family use and for emergencies.

CHAPTER VII

NATURE'S GIFT TO MANKIND

In the early spring, when the budding leaves convert the woodlands into an effective canopy of fresh yellowish green, one may observe in the open spaces, poking up through the dry carpeting, irregular circular clumps of umbrella-shaped leaflets, which gradually unfold as the days go by, until the space for a foot or more above the ground is covered with a mass of brilliant foliage. These beds are striking objects on the landscape at this season of the year in the rich woodlands east of the Mississippi, and are familiar to the most casual observer traveling through the country, whether on foot, by automobile, or by train. They are colonies of the May-apple, or mandrake, indigenous to North America, and one of our most valuable drug plants.

A few inches below the surface of the ground, overlapping and interlacing, the sinuous roots spread out in all directions, often from six to ten feet in length, forming a tangled network. In this root nature has provided a metabolism that produces a bitter agent having a specific action on that important organ of mankind, the liver; and year by year it is being generated by the countless and seemingly inexhaustible colonies of May-apple plants. This complex sub-

stance, really a mixture of two individuals,[1] has never been produced outside of this laboratory of nature. What the steps are in the process we do not know, but they are more wonderful than any that have yet been developed in the best equipped chemical laboratories of modern times. Working under natural conditions, unaided by high temperatures and pressures or by drastic reagents, the vital fluids of the mandrake root quietly react to produce those bodies which, from the day that some prehistoric Indian discovered their virtues, stimulated the livers of the red men down to the time that Columbus came, since which time they have aided countless thousands all over the globe—a contribution from the New World.

The American mandrake should not be confused with the mandrake cited in the Bible. The latter is a species of mandragora, a plant allied to the belladonna group, containing active principles of entirely different characters. Of late a variety of true mandrake has come on the market from India, and this is fortunate, because our native supplies are not inexhaustible, the annual drain being enormous and continually on the increase.

The processes by which the active principles are generated and stored away in the cells of a plant are among the most marvelous of natural phenomena. The cinchona tree produces quinin; the nux vomica bush strychnin; morphin and a host of other alkaloids are synthesized by the maturing poppy; santonin by a variety of wormwood allied to the absinthe plant; and atropin by the belladonna shrub. None of them has

[1] Podophyllotoxin and picropodophillin.

been duplicated in the chemical laboratory, though the researches on the artificial production of quinin have resulted in the discovery of a host of valuable drugs, of which antipyrin is perhaps the most striking example.

The secretion of the active principles occurs during the active growing stages of the life history of the plant, often reaching its height just before it launches forth on those phases of its activity that develop the means for its reproduction. For example, the growing belladonna shows a gradual increment in the percenttage of atropin up to the time that it is in full flower. At the height of the season it may show two or three times the potency it had when it was putting forth its branches and developing its leaf system. After the flowering period, the metabolic processes secrete less atropin, and hence the potency diminishes gradually up to the cessation of growth.

It is an observation of considerable significance to the chemist that the synthesis of these important plant principles, chemical individuals themselves, each with its own complement of atoms unvarying in number and character of grouping, occurs within a range of only a comparatively few degrees of temperature. To bring about chemical synthesis in the laboratory a high temperature is usually required, and in order to consummate the reaction, the assistance of pressure, produced by artificial means, is often essential. Oil of wintergreen, a valuable medicine for rheumatism as well as a delightful flavoring agent for confectionery, can be made artificially, the synthetic product having exactly the same composition as the natural oil

and answering the same purposes. Pure oil of wintergreen is a chemical individual, as are quinin and strychnin, differing, therefore, from most other flavoring and medicinal oils, which are usually mixtures of varying quantities of several different substances. Unlike quinin or strychnin, however, it is of relatively simple composition, being a derivative of salicylic acid, known in chemical nomenclature as methyl salicylate. Though this oil is associated particularly by the non-scientist, with the pretty little wintergreen plant, or checkerberry, the same substance occurs in the bark of sweet birch, from which source the natural oil is now almost exclusively distilled.

The production of the artificial oil is accomplished only with the aid of high temperatures and pressures, and by the inter-reaction of strong chemicals. Carbolic acid and caustic soda in proper proportions are introduced into a tight iron drum, where the mixture is brought to a high temperature by means of artificial heat. Inside the drum a high pressure develops, and carbonic acid is pumped into the molten mass. There is thus formed a substance known as sodium salicylate, the sodium salt of salicylic acid. When the reaction is complete, the mass is cooled, dissolved in water, and treated with muriatic acid (hydrochloric acid), which decomposes the sodium salicylate. From this liquid the salicylic acid crystallizes. The separated acid is mixed with methyl alcohol and heated under proper conditions in the presence of strong sulphuric acid, or oil of vitriol. It is in this way that methyl salicylate is formed, after which it is separated from the crude mixture by distillation,

MANDRAKE OR MAY APPLE IN ITS NATIVE WOODLAND

CHIONANTHUS VIRGINICA

The Beautiful Fringe Tree of the South

TURKEY CORN AND TRILLIUM

WILD VALERIAN

LADY'S SLIPPER PLANT

The Cypripedium of the Nerve Remedies

and then purified. The resulting substance is identical in every respect with the pure oil distilled from the leaves of the wintergreen herb, or from the twigs and bark of the black-birch tree. But how different is its mode of creation from the unobtrusive processes taking place in the metabolism of the producing agents of nature!

During the millions of years that have elapsed since the inception of the Proterozoic age, when life was beginning to appear on the earth in its lowest forms as represented by the animalcula and protozoa, the evolutionary processes have gradually developed a countless number of microörganisms, parasites, and contagia, responsible for the various diseases and pathogenic conditions to which the human race is susceptible. Coincident with this growth, and ever since plant life became a feature in the economy of nature, there have been evolved the remedial agents needed by man to combat the pathogenic hosts.

Primitive man found relief for his ailments from the herbs of the field and forest, and as his knowledge and experience increased the first elements of medical science were assembled. Garrison [2] in a summary of the development of medical plant lore, says:

The hieratic writings of the Egyptian papyri reveal an unusually extensive materia medica, the excellence of which is vouched for in the Homeric poems, and which can to-day be duplicated, in extent at least, in the materia medica of old civilizations like China or Japan, or even in our own bulky pharmacopœias. We find that savages in different countries knew instinctively the most fatal arrow-poisons—curare, ouabain, veratrin, boundou—as well as the virtues of

[2] "History of Medicine," 1913, p. 21.

drugs like opium, hashish, hemp, coca, cinchona, eucalyptus, sarsaparilla, acacia, kousso, copaiba, guaiac, jalap, podophyllin, or quassia.

Not to go further than our own country, we find the North American Indians aware that arbutus is "good" for rheumatism; lobelia for coughs and colds; wild sage tea, golden-seal, flowering dogwood, and prickly-ash berries for fevers; elder, wild cherry, and sumac for colds and quinsies; wild ginger, ginseng, and euphorbia for digestive disorders; inhalations of penny-royal for headache; sassafras or violet leaves for wounds and felons; and the roots of sassafras and sarsaparilla for "cooling and purifying the blood."

In 1535-36 the Iroquois around Quebec, as Jacques Cartier relates, treated scurvy in his crew very successfully with an infusion of the bark and leaves of the hemlock spruce; and the French at Onondaga in 1657 found the sassafras leaves, recommended by the same tribe, "marvelous" for closing wounds of all kinds. The "Materia Medica Americana" (1780) of the old Anspach-Bayreuth surgeon Schoepf, who came over with the Hessian troops during the war of the Revolution, shows that the Anglo-Saxon settlers in the New World had already learned many wrinkles in herb-therapy from the red men, in addition to the very rich medical folklore which they undoubtedly brought with them from Old England. The plant-lore of rural England included a knowledge of the virtues of camomile, sage, and dandelion teas as laxatives; of marjoram and primrose root for headache; of wormwood as a tonic; of valerian for the "nerves"; of agrimony and parsley for jaundice; of meadow-saffron (colchicum) for gout; of fennel, eye-bright (euphrasy), and rue for bad eyesight; of male-fern and peach-leaves for worms; of tansy as a vermifuge and abortifacient; of horehound, marshmallow, or candied elecampane for coughs and colds; of foxglove as "the opium of the heart"; and of moonwort, alehoof, and goldenrod. English poetry and folk-lore are

full of references to thyme and marjoram, rosemary and rue, mistletoe and ash, as well as poisons like hemlock, leopard's-bane (aconite), the deadly nightshade (belladonna), "the juice of cursed hebenon" (yew), and henbane (hyoscyamus), which Aretæus regarded as a cause of insanity and to which Shakespeare refers in the same spirit as

"the insane root
That takes the reason prisoner."

Asphodel, or dittany, is often mentioned in the Homeric poems as a balm against the pain of newly inflicted wounds, and the same tradition is still current among the country folk of Lancashire, Ireland, and the moors of Scotland.

The extent to which nature's storehouse is drawn upon for some of our most extensively used medicines is almost beyond comprehension. Hundreds of tons of botanical drugs are annually converted into proprietary remedies for direct sale to the public. Equally large quantities are absorbed by the medicine manufacturers who produce the countless formulas sold by the druggist and prescribed by the physician. Lloyd,[3] as a result of a research into the extent of the employment of vegetable drugs by American physicians, found that, with all classes of practitioners, ten of the drugs prescribed most frequently included aconite, bryonia, cimicifuga (black cohosh), belladonna, nux-vomica, gelsemium, veratrum (American hellebore), cactus, pulsatilla, and echinacea (purple cornflower). In the course of his inquiry he received replies from more than ten thousand general practitioners, with more than six thousand of whom cactus was cited as a dependable remedy, either as a sedative, a diuretic,

[3] Journal American Pharmaceutical Association, 1912.

or for diseases of the heart. More than five thousand of the same group of physicians employed, in the order cited, hydrastis (golden-seal) aconite, gelsemium (yellow jasmine), ipecac, digitalis, ergot, belladonna, nux vomica, hyoscyamus (henbane), and echinacea.

Professor Lloyd's inquiry showed conclusively that practising physicians made free use of the natural drugs. Not only did they place dependence on those above mentioned, but also on some two hundred or more representing a great variety of types. The data obtained referred only to the use of the drugs themselves in some form or other exhibiting the individual in its entirety. They did not include information on the extent to which use was made of the pure active principles of the botanic drugs, such as strychnin, morphin, quinin, etc. For instance, santonica, the Levant worm-seed, is seldom employed as a remedial agent, except perhaps in veterinary practice, but its characteristic principle, santonin, is one of the most dependable remedial agents in the materia medica. Similarly, tea and coffee would hardly appear on a list of commonly used drugs, but they both yield caffein, a safe and valuable stimulant to the mental processes and a defense against fatigue.

By far the greater part of the vast volume of botanical drugs compounded into medicines are obtained from natural sources. In locating her laboratories in different parts of the world, nature selected, as one of them, a vast wilderness in the mountainous region which one day was to be the southeastern United States. Here, in what is now southern Virginia and North Carolina, there gradually developed through the

ages a wonderful flora, influenced by the tropics on one side and the bracing climate to the northward, of which perhaps some six hundred or more species have had medicinal application. Out of this Blue Ridge section of the Southern Applachian System now comes 75 per cent. of North America's contribution to the drug supplies of the world.

Ewing and Stanford[4] have written an interesting account of a personal survey of the botanical resources and the methods pursued by the drug-collectors in this region. They found that:

> Crude drugs are collected in small amounts by a large proportion of the people of the mountains. Few, or none, gather drugs as a chief occupation. The mountaineers, in general, make their principal livings on tiny hillside clearings. Because of the rugged character of the land, which unfits it for machine farming, large plantations are rarely found. Marketing of farm crops in large amounts is also difficult, owing to the steep grades and poor repair of the mountain roads, which in many places are little more than bridle-paths. Work away from the farms is normally scarce and wages are extremely low. Drug-collection is carried on largely when no other work offers, chiefly by the women and children, and is a rather haphazard process. The men, in general, consider such occupations beneath them, and collect, ostensibly, only heavy and bulky products, such as barks of the larger trees, and bring in the other products with an apologetic "Here's some yarbs the women got." The principal collecting seasons are spring, when most barks and some roots are gathered, and late summer, when the crops no longer need cultivating, and herbs, leaves, and flowers abound, and roots may be distinguished by the herbage. . . .

[4] *Journal* American Pharmaceutical Association, 1919, p. 16.

The firms of the Blue Ridge region, with one exception, grind no drugs.

Incoming stocks are, in some cases, inspected by the dealer in person. A number of firms employ comparatively young men as inspectors; in other cases, veterans grown old in the trade pass on the drugs. These inspectors, apparently without exception, are without scholastic training in science, and in some cases are quite illiterate. Scientific names of drugs are almost unknown. Microscopic and chemical tests are not resorted to. Even a hand-lens is rarely or ever used. Appearance, odor, taste, and "feel" are the chief criteria. With long experience, these inspectors attain a remarkable proficiency. Some even claim sound as definitive. One veteran, in search of certain material, went through a pile of unmarked bags, announcing the contents of each after a thrust or shake. Interrogation brought forth the modest response, "I reckon I tell 'em by the rattle."

Colored help is frequently employed in the warehouses, but the inspectors are almost invariably white. One colored veteran, however, boasted an experience of forty-two years. While unable to read or write, he has a wide reputation as a "doctor" among his own race, and even is said to "send medicines North." The knowledge of these inspectors as to the various properties of the products they handle, and of other locally used "medicinals," is an interesting blend of hearsay, superstition, tradition, and folklore, some of which, indeed, is hardly peculiar to this region alone. Beech-drops (*Epiphegus virginiana*) "drop from the beech limbs and take root." "Mold"-bean is so called in the erratic local orthography because it "keeps moles out of the gardens." As castor-bean, this plant has attained rather a wider celebrity. Spicewood leaves, dittany tea, and a tea made from the excrement of sheep are sovereign remedies to "bust out measles." Buckeyes are carried in the pocket as a cure for piles. Black-willow buds

and bark are "a great friend to man" for their anaphrodisiac qualities. Pennyroyal leaves and cotton-root bark are said to be in common use as domestic ecbolics, although observations in the region would lead one to doubt their universal efficacy.

The natural supplies of drugs yielded by this producing area in our Southern mountains will be adequate for the demands of the medicine-maker for many years to come. But they are not inexhaustible, and year by year it becomes necessary to go farther and farther into the wilderness to gather the necessary amounts.

To follow the seasons in a region where the medicinal flora exists in its virgin state is a privilege that must be experienced in order to be appreciated, and as the years go by the opportunity to do so is passing. Outside of the comparatively inaccessible mountainous country where drug-collecting forms the chief remunerative occupation of the inhabitants, there are very few localities in which one can observe an array of medicinal flora growing undisturbed. There is, however, one spot not far from the national Capital where an organization, known as the Washington Biologists' Field Club, has been able to maintain, against all artificial encroachments, a shrine of nature in all its primitive attractiveness. Here, on the shores of the Potomac, a bit of the Piedmont,[5] some fifty acres

[5] The term "Piedmont" means the foot of the mountain, and it is customary in many countries to give this term to a belt of country lying at the foot of some prominent range and extending indefinitely away from it. Originally the local usage restricted the term "Piedmont" to a belt some thirty or forty miles wide lying just east of the Blue Ridge and including on its surface a number of isolated knobs and ridges that clearly distinguish it from the more perfect

in extent, representing woodland, swamp, and river-bottom, has been kept just as nature prepared it centuries ago for the wild life that has come down to the present day. Due to a policy of intelligent conservation, the native flora has flourished to such an extent that to-day the fame of its beauty and variety has spread all over the country wherever there are men and women engaged in biological pursuits, and if their travels take them to Washington, one of the first requests is to be shown the treasures at Plummer's Island.

It is impressive to view the succession of blooming flora that accompanies the changing seasons, from the time when the first hepaticas bend their delicate purplish-white and blue petals to the February winds, until the lingering cardinal-flowers, wahoo, and spice-berries give a touch of brightness to the somber woods

plain farther east. It is recognized as extending from South of New York State down into Georgia. The eastern boundary is marked by the so-called "Fall" line.

The old continental area that once extended out beyond the margin of the Atlantic gradually sank in the east until the sea came inland to a line marked by the cities of Philadelphia, Baltimore, Washington, Richmond, Columbia, Augusta, Milledgeville, Macon and Columbus. In the meantime, the Appalachian region and the Mississippi valley were raised above sea-level and the continent took on somewhat the same outline that it has to-day. From that time up to the present there have been periods of deposition on this eastern shore, but the material laid down upon it has not had time to become consolidated, and hence it consists largely of sand, gravel and clay. Such material weathers down much more rapidly than hard rocks, and hence the region east of the line mentioned above is generally much lower, has more subdued topography, and is in every way separate and distinct from the Piedmont Plateau. The belt of zone along which the sediments lap onto the old continental mass is known as the Fall line or Fall zone. This line or zone is marked generally by falls or rapids in the streams crossing it—hence the name, and this fact has been largely responsible for the location of so many cities at these points.

in late autumn. In March the feather-like leaves of the turkey-corn form dense irregular masses where the soil is rich and soft, and soon the queer-shaped white blossoms appear that give to the plant its colloquial name, Dutchman's-breeches. The miniature tubers of the root systems, responsible for the synonym turkey-corn, furnish the medicine-makers with some of the ingredients for their alterative mixtures, or what are better known as "blood purifiers."

Following closely on the blossoming of the turkey-corn comes the beautiful pure white star-like blossoms of the sanguinaria, or bloodroot, famed for its efficacy in relieving the spasms of bronchitis and other forms of obstinate cough. Before the bloodroot passes, a yellow flower, seemingly out of place at this time of year, becomes conspicuous in the woodland. It is the golden ragwort or life-root, famous as a tonic and diuretic, which is sought for as an ingredient of some well known "female" remedies. This plant is closely related to the great group of asters and other species associated with the blossoms of the late summer and early autumn. The golden ragwort is the first of the order to blossom in the northern Piedmont. It is ahead of the advance-guard that appears with the riot of blooms filling the woods and meadows in May, and is therefore worthy of note, both on account of the hue of its petals and the conspicuous place it occupies in relation to other species flowering at this early date. Comes now the mandrake, filling the open glades with its five-lobed umbrellas, while in the cool shade of the northern slopes is found the inconspicuous Canada

snakeroot, or wild ginger, whose aromatic root is a mild and pleasing tonic for the rebellious stomach.

As the weeks go by, the two cohoshes, blue and black, develop their bushy growth. The latter sends up a long spike, often as high as a man, topped with a raceme of white feathery florets. The roots of both plants have valuable medicinal properties, being uterine stimulants and featuring in the composition of many "female" remedies and viburnum compounds. Black cohosh, also called macrotys, has attained considerable reputation in controlling St. Vitus's dance and other disorders of the nervous system.

Early in May, on the rocky slopes, the beautiful fringe-bush puts forth its white drooping blooms, filling the air with their perfume and rivaling the Japanese honeysuckle, which is also in blossom at the same period, in charging the atmosphere in the morning hush with layer upon layer of exquisite fragrance. The bark of the root possesses tonic properties of peculiar value to convalescents from exhaustive diseases. As spring wanes, the Indian hemp, useful in dropsy and Bright's disease, and the orange milkweed or pleurisy-root, stimulated by the rising temperature of early June, assert their presence, the former by the fence-row, the latter in the neglected fields.

The profusion of color passes with the coming of midsummer; but the hot-weather flowers possess as much fascination to the drug student as do those of early spring. Now comes lobelia inflata or Indian tobacco, with its attenuated petals surmounting the little globular seed-pods. The leaves and tops fur-

nish a drug extensively used in asthma remedies. Jimson-weed, datura stramonium to the botanist, appears with its rank growth along the edges of the woods and fields. The leaves of this plant also are employed for asthma, besides being one of the sources of atropin, the indispensable ally of the oculist. In late summer boneset, useful in cases of cold and fever, with its peculiar perfoliate leaves and veil-like crowns of white, is conspicuous in the damp gullies and rich soil of the swamp borders. And in September lobelia syphilitica, blue, like the northern gentians, and the brilliant cardinal-flower, still another member of the lobelia group, tint the fading glory of the woods with their contrasting colors.

So the sequence advances through the seasons. Virginia bluebell, grape-hyacinth, blue phlox, sweet cicely, and dogtooth, blue, and white violets, canopied with flowering dogwood and red-bud, complement the setting in the early spring days, while the air is redolent with the perfume of the honey-locust blossom. Later comes wild valerian, chrysoganum, and prickly-pear, which is the Eastern representative of the cactus tribe, to be followed in midsummer by the milkweeds, butter-and-eggs, as well as the tall stalks of wild lettuce. Wild ipecac in the uncultivated uplands, the spurges, goat's-rue, and New York ironweed, conspicuous with its bold heads of royal purple, characterize the blooms of the waning summer, while the splashes of color amid the sumacs and Virginia creeper presage the approaching transformation of the woodlands with the coming of the harvest season.

A full realization of the significance of botanical

drugs in their relation to the ills of humanity cannot be acquired solely by association with herbarium specimens, or the bales and bags of the warehouse. One must penetrate into their habitat and at leisure assume a speaking acquaintance with the living individuals. It is only thus that there finally becomes manifest a confident appreciation of the part played by nature in providing the antidotes for the morbid afflictions of mankind for which he is also responsible.

There are many interesting features connected with the distribution of the producing localities of the common natural drugs. We have devoted some space to noting the species peculiar to the producing area in the southeastern district of the United States. Here originate many varieties that are in general use not only in this country, but all over the world, wherever medicines are manufactured. On the western coast, extending its range into British Columbia, is found the cascara tree. This locality furnishes virtually all of the cascara bark that is incorporated into the thousands of laxative pills, tablets, and tonic mixtures featuring this important remedial agent.

Balsam of Peru, a fragrant aromatic gum-resin, useful as a stimulating antiseptic for deep-seated coughs and catarrhal conditions, does not come from Peru, but from a spot on the western coast of Salvador. The tree yielding the balsam is one of the most beautiful of the tropical forest, often towering upward to more than one hundred feet in height. It begins to give up its sap when it is about twenty years old, three or four pounds of the thick liquid being collected each

season, and it continues to yield its annual tribute until the century mark is reached.

In three spots on the globe, remotely separated from one another, are found three drugs differing in appearance and chemical constituents, but used by the native population for purposes of a similar nature. These are the cola nut, coca leaf, and leaves and twigs of the pituri. The cola is an African product, coca originates in Peru and Bolivia, and pituri flourishes in Central Australia. They are taken by the inhabitants because of certain stimulating properties that enable the consumers to perform much labor and go long journeys with but little food.

Coca is employed more extensively than all of the other stimulating drugs combined, estimates numbering the users in South America as between eight and ten millions. The native Indian laborers consume, on the average, two to three ounces daily, masticating the leaves with a small quantity of lime, and seemingly with as great a relish as is enjoyed by the tobacco-chewers of the North. Indian foot messengers plying their tracks across the hazardous passages of the Andes will carry a pocket full of coca leaves, but no other form of nourishment. They will continue an uninterrupted course, often of three days' duration, depending solely on the stimulus of the venerated coca.

One of the most valuable of all the gifts of nature is the product of a tree growing in the almost inaccessible confines of Burma in British India. It is the substance known as chaulmoogra oil, yielded by the seeds of a tree rejoicing in the name of Taraktogenos kurzii.

Though this oil does not fall in the same class as such drugs as nux vomica or cinchona, remedial agents of a wide range of application, it has been found of great value in curing leprosy, and hence, in its own sphere of usefulness, possesses an importance of the highest degree.

The fact that the oil of an Indian tree was prized as a remedy for leprosy has been known for centuries. The old Buddhist histories relate the legend of a Burmese king, voluntarily exiled for leprosy about one thousand years ago, who cured himself with this oil, and likewise effected the cure of a beautiful young woman whom he afterward married. But until a few years ago no white man had ever seen the tree yielding the seed in which the oil is contained.

An extended investigation of the constituents of chaulmoogra oil and some related products was made several years ago by Dr. Frederick B. Power and his associates in the Wellcome Chemical Research Laboratories, London. This resulted in the isolation of two, crystalline, optically active, unsaturated acids of an entirely new type, which hitherto had not been found to occur in any fatty oil. These acids, which were designated respectively as chaulmoogric acid, and hydnocarpic acid, constitute what is now known as the chaulmoogric acid series. Numerous derivatives were made of the acids, including their ethyl esters. The latter have been used in recent years, in the form of intramuscular injections, in the treatment of leprosy with very remarkable results, and have been regarded by some as a specific in that disease. A full account of the above-mentioned investigations,

which occupied several years, will be found in the *Transactions of the London Chemical Society,* 1904 to 1907. Since then chaulmoogra derivatives have been administered wherever the treatment of leprosy has been under systematic management, and in the Hawaiian colony more than two hundred cures have been effected.

The natural consequence of this comparatively recent development of a method of treatment that has dozed along for a thousand years has been a realization that some provision must be made for obtaining the raw material without the necessity of depending on the only supplies heretofore available. The native inhabitants collect the seeds according to the dictates of their desultory nature, and as the habitat of the trees is a country infested with tigers, bears, and all sorts of dangerous creatures, the former preying on the natives and the latter competing with them in gathering the mast, the uncertainty of sufficient material for preparing a normal quantity of the medicine is always a menace.

Fortunately for the future unhappy sufferers of the dread malady, plans are now under way for establishing a plantation of the taraktogenos trees in the Hawaiian islands. One of the agricultural explorers of our government, Joseph Rock, has penetrated the all but impregnable jungle, and collected a sufficient quantity of the mature fruit to provide the nucleus for the future groves on which will depend the supplies of chaulmoogra oil needed for medicinal purposes.

There are latent possibilities existing in many other

drugs from natural sources. Certain of them are already under investigation by progressive workers in the fields of medicine and pharmacy. As an illustration, we will cite the root of the ginseng, which from time immemorial has been a revered specific among the Orientals, though looked upon with derision by the advanced therapeutists of the Occident. It is an interesting anomaly that the consumers of the drugs depend for their supplies on a country having no respect for its efficacy. The natural supplies of China and Korea were inadequate to satisfy the requirements of the population of these countries, who at last became dependent on the harvest of the native plantations, until it was discovered that in North America there were apparently inexhaustible quantities, thus averting the menacing ginseng famine. However, the exploitation of the American stock was greater than its ability for reproduction, so that by the end of a couple of centuries the famine again threatened. At the present time our exports of the drug consist, in the main, of cultivated ginseng, the production of which was successfully instituted and has been consistently followed for many years.

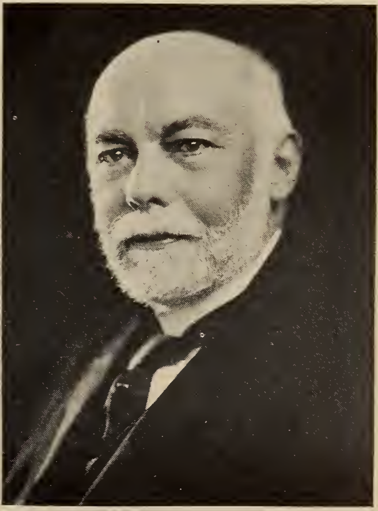
A study of the constituents of the ginseng root was inaugurated by the scientists of Japan within the present decade. Thus far there has been reported the discovery of several chemical individuals, new to the scientific world, and which are evidently peculiar to the ginseng. Whether or not these new bodies represent the reported virtues of the drug, and possess a potential significance that further experimentation will determine, is something for future revelation.

CHAULMOOGRA TREES GROWING IN BURMA

Photographed by Joseph F. Rock. Courtesy and copyright by National Geographic Society, Washington, D. C.

FRUITING BRANCH OF CHAULMOOGRA

Photographed by Joseph F. Rock. Courtesy and copyright by National Geographic Society, Washington, D. C.



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FREDERICK B. POWER

WILD GINGER OR CANADA SNAKE ROOT

SANGUINARIA CANADENSIS OR BLOOD ROOT

WILD DIGITALIS

FLOURISHING CLUMP OF CYPRIPEDIUM

Work of this nature, that is, the chemical investigation of the constituents of drugs, has been fostered in recent years both at home and abroad, and consequently has resulted in a great advancement of our knowledge of the subject. In England this advancement is largely to be attributed to the scientific spirit and generosity of Mr. Henry S. Wellcome, who, as an American citizen in London, established about twenty-five years ago the chemical and the physiological research laboratories which bear his name. Dr. Frederick B. Power, also an American citizen, was appointed in 1896 to undertake the organization and direction of the chemical research laboratories. It was while in this position, as already noted, that he and his associates undertook the chemical investigation of chaulmoogra oil, and isolated therefrom the peculiar acids which represent its active constituents. Under his direction researches on the chemical composition of many plants and plant products were conducted and a large number of new substances discovered. Among the important drugs studied there may be mentioned sarsaparilla, dandelion root, rhubarb, senna, jalap and scammony resins, colocynth, elaterium, bryony root, hops, gelsemium, wild cherry bark, red clover and carnation clover flowers, "Yerba santa" (*Eriodictyon*) and "Yerba buena" (*Micromeria*), grindelia, Culver's root (*Leptandra*), wahoo (*Euonymus*), blue cohosh (*Caulophyllum*) and the so-called Queensland asthma herb (*Euphorbia pilulifera*), together with several essential oils. Through the work of Dr. Power and his associates many of the secrets locked in nature's vast storehouse have been

disclosed and the advancement of phytochemical science has thus been markedly stimulated.

One of the most striking examples of the peculiarities of nature in the distribution of plant species occurs in the case of santonica, or Levant wormseed, the drug yielding santonin. The plant is a species of artemisia, a genus embracing many thousands of varieties all closely related, but the Levant wormseed is the only one developing santonin, and its habitat is the lonely wastes of the Russian steppes and Turkestan.

Santonin is an effective vermifuge, being surpassed by no other agent for removing the stomach and intestinal worms to which children especially are susceptible. Just prior to the beginning of the World War, its application was extended to the hog-raising industry, which bade fair to appropriate even larger quantities of the drug than were needed for the relief of human ailments. It had been discovered that by administering a few doses of santonin, combined with calomel and bicarbonate of sodium, hogs, which under normal conditions support flourishing colonies of parasites in their intestinal tracts, would be freed from these encumbrances. When thus treated hogs would show, at the time of slaughter, an increased weight over untreated hogs, all of the fat produced thus being available for human consumption in its entirety, and not in part, as formerly, to satiate the cravings of a host of hungry worms.

Coincident with the opening of hostilities, the world's supply of santonin, the production of which was controlled by the Germans under concession from the Russian government, was suddenly shut off, and

the famine bade fair to have a marked influence on the price of breakfast bacon. For four years meager quantities of santonin leaked out into the trade, and its use was limited to those firms able to pay the enhanced cost of the article, which was many times over and above the pre-war value. Subsequent to the Russian Revolution the forces of the Bolsheviki razed the isolated factories in the santonica fields, and thus an indispensable industry has been virtually annihilated.

In connection with the story of santonica it will be of interest to recount an attempt that was made to develop its production as an American institution and thus to provide our industries with their necessary requirements. The agricultural explorers of our national government, after many unsuccessful attempts to obtain a small supply of viable santonica seed, finally succeeded, in spite of apparently insurmountable obstacles, in procuring a quantity sufficient to establish a small garden on one of the experimental farms. The bushy plants flourished under the gracious climatic conditions of our Western coast, apparently the designated locality for establishing the species in this country. The unexpanded flower-heads, which constitute the commercial drug, occurring in myriads on every bush, were found to be rich in santonin, and in every respect equaled or surpassed the Levant worm-seed as it was known to the trade before the war. It is a peculiar provision of nature that the active constituent of this drug reaches the height of its development almost solely in the buds, and disappears when the flower bursts into bloom.

The fact that the plant adapted itself so readily to our climate and soil conditions inspired the hope that here was the nucleus of a new American industry. It was of sufficient importance before the war to induce the enterprising Germans to penetrate many leagues into the wilderness, establish their factories under the most discouraging conditions, import the materials required for extracting and purifying the santonin, and adopt every possible precaution to prevent the evasion of viable seed that might enable others outside of their jurisdiction to produce the santonin. A further inducement seemed apparent, since the industry had been virtually destroyed through the razing of the manufacturing properties. The investigators of the government and other scientists, appreciating the possibilities of the situation of possessing virtually the only available means of reëstablishing the santonin supplies of the world, were hopeful that American enterprise would visualize its significance and promote the ways and means for developing a new national institution. However, it would appear that our British cousins, who operate under a national policy perhaps a little more appreciative of the import and generous in the aid and support of new projects, will eventually take over the propagation of santonica, and manufacture the santonin used in the medicine and packing industries. America's disregard will be Great Britain's gain, and we can feel a sense of gratification that our own race will figure in the consummation of the project.

Stories without number might be recalled, featur-

ing the evolvements of nature through the ages since plant life first began to perpetuate itself, as well as their application to the relief of the many ailments with which savage and civilized man has been, and still is, subject. The unlocking of mysteries is a fascination to the biologist, the chemist, and the physiologist. Medical science strives to prevent disease as much as it aims to relieve the pathological conditions when once they are established. The employment for this purpose of agents created by natural processes in the metabolism of the vast and varied botanic life of the world almost surpasses realization. It is an acknowledgment of the dependence of mankind and his appreciation of the resources of the herbal world.

CHAPTER VIII

VACCINES AND SERUM-THERAPY

Some confusion exists in the mind of the average man and woman concerning the meaning of the terms "vaccine" and "serum." There is no misunderstanding about what is meant when the allusion is to smallpox vaccine, but serum appears to have a vaguer meaning, and the word is often misapplied. We speak of taking the serum treatment for hay fever and for typhoid, when actually we are inoculated with a form of vaccine in order to be made immune from attacks of these maladies.

In a broad sense, vaccines are used as prophylactics and are applied before the onset of the disease that they are intended to antagonize. Serums are used for combating a condition that is already established.

By vaccine treatment we subject a person to an attentuated or mild form of the disease, or to one that is closely allied to it. When we give a serum, it is for the purpose of supplying an antitoxin to destroy the toxins or poisonous substances with which the system has become charged through the action of the disease with which the patient is suffering.

Contiguous with the general advance in medicine and pharmacy in the present century, many special types of vaccines have been developed, some of which

are actually combinations of prophylactic agents and antitoxins; but this discussion will be confined largely to the simpler forms that have been noted.

Vaccines have been used for more than one hundred and twenty years, but serum-therapy, or the employment of antitoxins, is a comparatively recent institution, having its origin in 1894.

The use of vaccine as a prophylactic against smallpox was established by Edward Jenner, an English physician. His researches were undertaken to determine whether or not there was any truth in the belief of the English peasants that accidental cowpox (acquired by milking a cow) was a preventive of smallpox. A similar belief, current at the same time, was that the carrying of a cowpox scab in the clothing would dispel the disease. Jenner's discoveries left no doubt of the reason for this belief, as it is quite probable that the person became unwittingly inoculated or, as it is now termed, vaccinated.

Jenner's work proved beyond question that by producing cowpox the subject became immune to smallpox. The practice of vaccination has spread all over the world since his day, and is now universally employed in all civilized countries.

In the old days the practice consisted in inoculating with the discarded crust of a patient who had been successfully vaccinated, or by transferring to the subject a bit of lymph from a person who was undergoing a successful vaccination. The operation was anything but sanitary. Evil results often obtained, and no doubt many people died as a result of the treatment. These unfortunate circumstances incited a

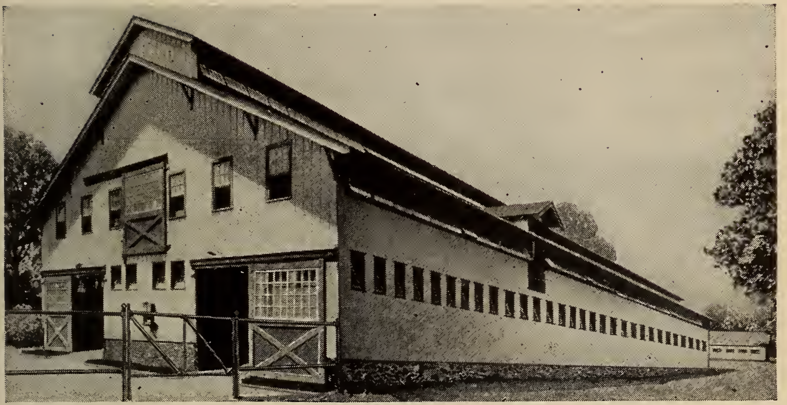
spirit of hostility, and a cult of anti-vaccinationists sprang into existence and has continued to this day. But all meritorious movements are beset by an anti-faction of some sort or other, and when it became apparent that soon after a country adopted compulsory vaccination the epidemics and deaths from smallpox diminished to the vanishing-point, the howls of the antis were treated with little concern.

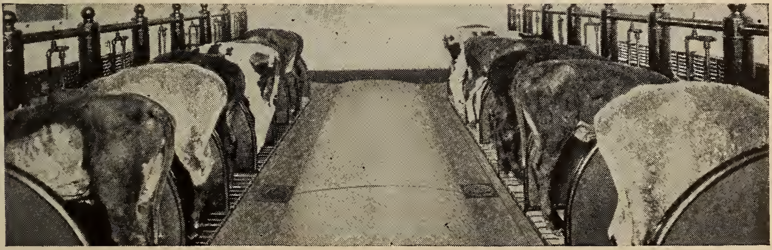
After the manufacture of medicines was divorced from the corner drug-store in the middle of the nineteenth century, and the pharmaceutical houses had become established on a substantial basis, it was suggested that vaccines might be produced commercially on a large scale. The importance of sanitation in the manufacture and use of these substances was recognized, and production under expert control and carefully observed conditions was the answer. The refinement in the methods of preparing these specialties have been due to the efforts of such firms as Parke, Davis & Company, Eli Lilly & Company, H. K. Mulford Company, and E. R. Squibb & Sons.

Smallpox vaccine is produced by inducing a healthy case of cowpox and removing the lymph when the disease is well established. Heifers and young cows are the animated medicine factories. The animals are received at the vaccine station, where they are given a careful physical examination by competent veterinarians. If there is any suspicion of disease the animal is rejected. Tuberculosis and foot-and-mouth disease are especially looked for. At a modern vaccine plant the cattle receive the best of care on a farm maintained with every appurtenance for their peace and comfort,

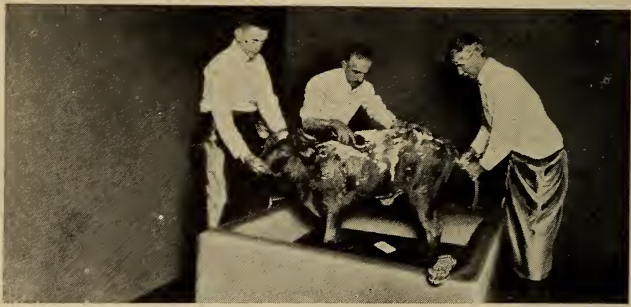
EDWARD JENNER

Who established the use of vaccine as a prophylactic against smallpox

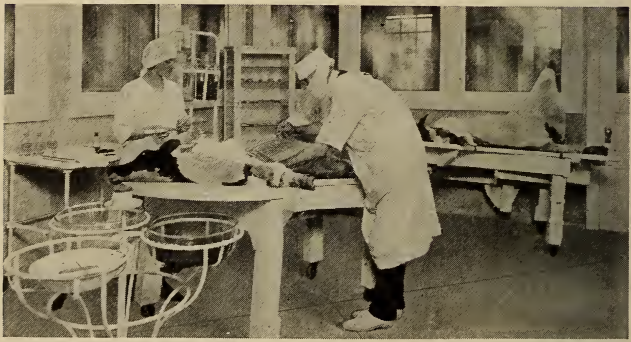




HOUSING ON A MODERN VACCINE FARM



Preparing a Heifer for Inoculation



Vaccinating a Calf with Cow Pox

Removing the Virus

THE MANUFACTURE OF VACCINE

and if any one has visited the beautiful farm at Glenolden operated by Mulford, or Lilly's well kept institution just outside Indianapolis, and an outstanding feature on the landscape as seen from the Pennsylvania Pullman, he will agree that the trite phrase "from contented cows" may well be applied to the lymph that is yielded by their animals.

After a period in which the animals become thoroughly at home, they are taken to the operating-room. Here the surroundings are as clean and as aseptic as will be found in any hospital of the highest repute. The attendants are dressed immaculately in white garments, and the accessories necessary for the work are all carefully sterilized. The animal is subjected to the restraint necessary for the operation, slung on a large operating-table, and inverted so that the abdomen may be cleansed and shaved. Then, by dexterious manipulation, the virus of the cowpox is inoculated on the field of growth, the animal restored to a standing posture, released, and led away to an individual stall. Neatness and cleanliness are the watchwords in the stables where the cattle remain during the incubation period. The floors, and often the walls, are of cement, and the stanchions and fastenings of enameled metal. Filth of no kind is tolerated, and, with constant flushings and the liberal use of antiseptics, the danger of contamination is kept at a minimum.

When an examination shows that a typical case of cowpox is well established, and the abdomen is covered with a liberal sprinkling of healthy "takes," the animal is brought back to the operating-room, again

subjected to restraint, and the lymph removed. In a large plant the operations are progressing all the time; fresh cows are being inoculated, others are giving up their virus.

The collected lymph is then examined bacteriologically to determine its purity and freedom from possible contaminating organisms. When its good quality has been established, it is mixed with the proper ingredients, including glycerin, which acts as a preservative, and then introduced into the little tubes, or by dipping transferred to the sharp bone or ivory points.

When the cattle have served their purpose as propagating mediums, they are turned out to pasture for a time, and when fully recovered go into the market again. Accessions are constantly being received, and altogether the handling of the animals resembles the operations of a miniature stockyard. It is all done under the supervision of federal inspectors and by virtue of government license.

Smallpox vaccine is really an attenuated living virus. Of similar character is anti-rabic vaccine, which has been used with considerable success as a prophylactic against hydrophobia. By treatment with this remedy after the bite of a rabid animal, immunity is usually established before the incubation period of the disease is concluded. The virus is prepared by inoculation of rabbits, by progressive treatment whereby the virus is passed from one rabbit to another and becomes virtually non-virulent for human beings. The spinal cords of the infected rabbits are dried and preserved with glycerin. When an application is to be

made, a piece of the preserved cord is shaken up with a sterile weak solution of common salt, and injected into the tissues under the skin over the abdomen. This is what is commonly known as the Pasteur treatment. The idea had its origin with this great investigator, and the process of manufacture, as described above, was worked out by him.

Autogenous or bacterial vaccines, which have come into prominence in the past few years, are suspensions of killed bacteria in salt solution, preserved with some antiseptic agent like carbolic acid. The best results have been obtained with the particular strain of bacteria at work in the patient on whom it is proposed to apply the treatment. For instance, if one is suffering from a chronic condition, and the discharges are accompanied by some pathogenic bacterium, a pure culture of the organism is obtained and allowed to produce many billions of its kind in the proper medium. After a period of growth a count is made, the bacteria killed by immersing the tube in hot water, and then mixed with the proper quantity of salt solution. These solutions are adjusted so that the physician can inject five, ten, fifty, or as many million bacteria as he deems proper at a dose. Stock vaccines of this nature are prepared for general use, and as a representative of the general class the typhoid vaccine has proved of great value. How beneficial are the results of inoculation against typhoid are apparent to those of us who recall the condition of our troops when they returned from the Santiago campaign ravaged with disease. In marked contrast to this was the practical absence of typhoid among the soldiers

in the World War, due to the universal use of the protective vaccine.

The popularly termed serum treatment for hay fever is not a serum treatment at all. Neither is it, strictly speaking, a vaccine inoculation. In theory the treatment consists of a prophylaxis or immunization against the action on the system of the pollen of certain plants; but the agents employed do not contain attenuated or dead microörganisms, which are characteristic of true vaccines. Hay-fever conditions are brought about by the action of certain substances known as toxalbumins on the mucous membrane of the eyes and nasal passages. These toxalbumins contain nitrogen, and are probably related to the proteins. They are present in the pollen of many plants, and during the flowering period, when the minute particles of pollen fill the atmosphere, a susceptible person suffers from hay fever. Some people react to the pollen of the pine-tree, some to the rose, others to that of various grasses, goldenrod, and ragweed.

The immunization treatment consists in the injection of gradually increasing doses of an extract made from the pollen grains. The plants employed are collected just before the flowers are full blown, nursed into bloom, and the pollen allowed to fall on clean cloth or paper. A sufficient amount is dried, ground up in a ball-mill to destroy the cell membrane, treated with a solution of salt, which dissolves the albuminous substances, concentrated, and purified. The active substances are then dissolved in sterile salt solution and are ready for use.

True serums or antitoxins differ entirely, in their

character and mode of action, from vaccines. Animals are used for preparing them, but the products obtained do not contain attenuated living organisms, nor do they consist of suspensions of dead bacteria.

When certain pathogenic or disease-producing bacteria, such as the germs of diphtheria or lockjaw, grow in a favorable medium, they excrete poisonous substances called toxins. If the bacteria are growing in the blood of a human being, the toxins produced bring about the disturbances in the system that characterize the disease. Thus the toxin of the diphtheria bacillus and those of the lockjaw organism are the causes of the symptoms accompanying these baneful maladies.

It is a wonderful provision of nature that, when the system is invaded by a disease-producing bacterium, it tends to develop antitoxins to combat, and if possible neutralize, the effect of the toxins generated by the invading body. If the patient is of sufficiently robust constitution and responds to the aid of sustaining remedies, the antitoxin will eventually conquer, and recovery will take place. Often, however, in the case of diphtheria, and usually in the case of lockjaw, the virulence of the toxic substances overcomes the antitoxin naturally generated, and disastrous results follow. Hence, if at the onset of a case it is possible to provide the system with an antitoxin from an outside source, there is much greater likelihood of recovery. This, in a nutshell, is the theory of serum-therapy. Experience has shown that it rests on an unassailable foundation.

The practical use of antitoxin was developed by

German bacteriologists, particularly Dr. Behring, and it was introduced to the medical profession in 1894. It is now universally employed wherever diphtheria prevails. The death-rate from the disease has been enormously decreased through its use, and, if properly diagnosed in the early stages, the duration of a case may be markedly curtailed, and much of the attendant dangers eliminated, if antitoxin is applied immediately.

The production of diphtheria antitoxin is one of the most interesting processes of the manufacturing medicine industry. Horses are employed as propagating mediums. They are selected with due regard to their soundness and youth, and are usually heavy-set animals of the cob type. Before being treated they are kept under careful observation for a period, and when they have been given a clean bill of health by the veterinarian, they are taken to the biological stables. Here they are carefully groomed and fed, and close observation is kept of their physical condition to guard against occurrence of illness of any kind. The stables are kept as immaculately as are those housing the cattle used for producing vaccine. They are provided with an abundance of light and fresh air and a perfect system of drainage.

In the beginning of the process pure cultures of the diphtheria bacillus are planted in large flasks of sterile bouillon. The flasks are placed in an incubation oven at a temperature of about that of the human body. The bouillon is the soil on which the germs thrive. They multiply rapidly, giving off their virulent toxin, which passes into solution in the liquid. When sufficiently charged with toxin the bouillon is filtered,

first through paper, then through unglazed porcelain, in order to remove all of the bacteria. The strength of the toxin solution, which is now devoid of the germs, is ascertained by physiological tests on guinea-pigs, and it is then ready for injection into the horses.

The initial doses of toxin are necessarily small, and the response of the animals is carefully noted. There is usually a rise in temperature for a day or two, with perhaps some other manifestations of discomfort. As soon as normal conditions are restored, doses of gradually increasing amounts are given, until finally as much as a pint or more of the toxin solution can be injected without noticeable effect. When this point is reached the horses are known to be immune to the toxin. They are then practically animated antitoxin factories, and are ready to give up their serum.

In order to abstract the blood, a sterile instrument, called a cannula, is passed into the jugular vein. The blood is collected in large tubes, which are closed with sterile cotton and set aside until the clot separates. A quart or more is usually taken at a time. Blood consists of myriads of corpuscles distributed throughout a liquid that is designated in biological lore as serum. On standing, the corpuscles gradually collect together, or, as it is termed, clot. They separate in a dense dark-red mass, and squeeze out the pale-yellowish serum which remains as a limpid fluid.

When the separation of the serum and clot is complete, the former is drawn off into sterilized flasks, and a preservative, usually a weak solution of a substance called cresol, closely allied to carbolic acid, is added. The serum or antitoxin is then filtered and

placed in cold-storage until it is ready to be prepared for the market.

Before being introduced into the hermetically sealed glass tubes, the serum is tested in order to determine how many "units" of antitoxin it contains. A unit is that quantity of antitoxin that will so far neutralize 100 lethal doses of toxin for a guinea-pig weighing a little less than half a pound, that the animal continues to live on the fifth day after the injection. A *lethal dose* of the toxin is the smallest quantity that will kill a guinea-pig of the same weight on the fifth day.

Antitoxins for use in combating other diseases are prepared in the same way. The antitetanic or lockjaw serum was the first antitoxic serum produced, but it has not come into such universal use as has diphtheria antitoxin. Lockjaw results from the entrance of the microbe into the system through a wound sustained by rough contact with the soil or something that has been resting in the dirt, such as a rusty nail or splinter. The presence of the disease is seldom manifested until the tetanic symptoms appear. The toxin is slow to form, but it is tremendously potent, and by the time the unfortunate sufferer realizes his condition it is usually too late for the antitoxin to have any beneficial action. For this reason, the serum treatment has been less successful than in the case of diphtheria. However, if the antitoxin is applied immediately on exposure, the danger may be averted, though, of course, the patient will not always be sure that an infection has occurred. It is the practice now to inject lockjaw antitoxin whenever an accident case is treated, when the appearance of the wound indicates the possibility

SEPARATING THE SERUM FROM THE BLOOD CORPUSCLES

BOTTLES OF ANTITOXIN

FILLING THE ANTITOXIN SYRINGES

Injecting the Horse with Toxin

Drawing off the Antitoxic Blood

THE MANUFACTURE OF ANTITOXIN

of the dangerous infection of the tetanus microbe.

Antitoxins are used to some extent in the treatment of typhoid fever, pneumonia, and tuberculosis. The principle of the antitoxin treatment is used for neutralizing the venom of poisonous snakes, and an antivenom serum is now prepared commercially on a considerable scale. The venom of the rattlesnake, cobra, and other poisonous reptiles consists in large part of complex nitrogenous substances that resemble in their action the toxins produced by the pathogenic microorganisms of diphtheria and lockjaw. When the venom is introduced into horses it produces the same effects as are obtained when the toxins are injected. The animals react, eventually recover, and can sustain larger and larger doses of the venom. In time they become just as immune to the reptile poisons as they do to the bacterial toxins. The blood can then be drawn off, the serum collected, and the antivenom serum prepared for the market, precisely as in the case of the antitoxins.

The successful manufacture of vaccines and antitoxins demands the employment of highly specialized talent. The responsibility attendant to the operations is exacting. It can be accomplished satisfactorily only by those firms that can afford to carry an enormous overhead and stand the losses that occur every year in handling these extremely delicate commodities. Vaccines and serums are marketed with a time-limit guaranty, and if not sold at the expiration of that period are usually replaced by fresh stock, which, of course, is an added potential expense borne by the manufacturer.

Recent legislation has placed the entire industry under the supervision of the National Public Health Service, and any firm desiring to manufacture these products must satisfy the requirements of the government with respect to its responsibility. It may then operate under a federal license, and its entire equipment is subject to regular inspection.

The story of antitoxins is analogous in some respects to the story of electricity. We are familiar with the effects of electrical energy; we can control it and make it do anything we wish, but we do not know what electricity is. Similarly, we know what antitoxins will do, but we do not know what they are. The investigations of the future will be concerned with the separation and determination of the chemical nature of these bodies. When their make-up has been definitely established, we shall know whether or not they are simple substances that can be prepared by the reactions of the chemical laboratory, and, if they can, the inanimate implements and reagents of the manufacturing plant no doubt will be called into use to take the place of the herds of patient animals that annually yield up their blood to aid the cause of humanity. The substances that neutralize the toxins of diphtheria and lockjaw probably are just as definite in their chemical individuality as are the simple alkalis that neutralize the pungent and corroding acids. The establishment of antitoxins as permanent remedial agents was a wonderful accomplishment. In the not far distant future some great name will establish their identity and point the way to their synthesis by purely chemical means.

CHAPTER IX

IN THE SPIRIT WORLD OF MEDICINE: VITAMINES

When Dr. Wiley was autocrat of the breakfast-table, the festive calory was the unit on which the nation's meal-ticket was based. Dietetics revolved about this subtle factor of energy that differentiated between a well balanced and a deficient ration. Happy was the firm whose breakfast food showed a high calorific value of whole grains, nuts, and the like, rich in carbohydrates, protein, and fat; while fresh fruits and vegetables were tolerated more for the variety they gave to the diet than because of any great nutritive merit they possessed.

During the reign of the calory, foods were judged by their capacity to produce heat, this being considered a measure of the energy they were capable of furnishing. The non-scientist let it go at that; so did most of the scientific fraternity; but the question was sometimes raised as to whether production of energy and nutrition, or capacity to build up the tissues of the body, were one and the same thing. As one made a critical study of foods and observed their comparative effects on the health and physical growth, it seemed as if sometimes the calory were getting more credit than it deserved.

What is a calory? It has been a favorite term in

the language of the food technologist for a generation, and the leaders in the debates of the local welfare societies all over the country have shown a familiarity with it, surpassed perhaps only by the humdrum servant problem or the social evil. The calory is a unit of measure of heat-energy, just as the foot is a unit of length and the pound a unit of weight. It is itself intangible, but what it measures is tangible. It was first used to measure the fuel value of coal, and when the physicists got to the point of promulgating standards for calculating heat energy, they reduced everything to the metric system, providing that the unit should be called a calory, the amount of heat required to raise the temperature of one gram of water one degree on the centigrade scale. The business of buying and selling coal and other fuels has since that time been based largely on the analysis of the products, and on the fuel or calorific value that they possess, for there is a great variation among different grades of the same commodity.

The above definition applies to what we call the *small* calory. In comparing the values of food materials the *large* calory is usually employed—a unit that is one thousand times as great as the small calory, or the heat required to raise a kilogram (two and two tenths pounds) of water one degree centigrade.

Of course, by this process of calculation it is assumed that the amount of heat expressed in calories is equivalent to the energy that the body could obtain from a given weight of food material. The food value, fuel value, or, as it is sometimes called, the heat of combustion, may be determined experimentally with a

calorimeter, or it may be calculated by means of factors, based on the result of many experiments, showing the average values for fats, carbohydrates, and proteins. According to these factors, the amount of energy in one gram of each of these classes of food materials is 9.3 for fats, and 4.1 each for carbohydrates and proteins. Expressed in pounds, each pound of fat has a fuel value of 4220 calories; each pound of carbohydrates or protein, 1860 calories.

The estimation of the fuel value by means of the calorimeter is an exacting process. The apparatus consists of a cylindrical-shaped bomb lined with gold or platinum, adapted to hold the sample, and containing oxygen gas under pressure. The bomb is immersed in water contained in a metal cylinder, which is in turn placed inside of concentric cylinders containing alternately air and water. For measuring the heat developed, a delicate thermometer, graduated to one hundredth of a degree, is suspended in the water surrounding the bomb. When all is ready, an electric current is passed through wires to the interior of the bomb, where, as a result of the cleverly devised mechanism, a spark ignites the sample, causing complete combustion of all the burnable ingredients in the atmosphere of oxygen. The rise in temperature is noted from the thermometer, and from the data thus obtained the food value is calculated.

So, when the science of food technology reached the point where food values were studied, it was decided that, as our foods were burned up, so to speak, inside our bodies, their worth or worthlessness could be ascertained by the same criterion that was employed

in judging whether a grade of coal from West Virginia were better than one from Pennsylvania.

Scientific work has become so specialized in the past quarter of a century that each branch requires the almost undivided attention of those specialists who have chosen that particular field of activity, while the workers in each field are probably numerically greater than the entire scientific fraternity of a century ago. The professional roster of the branch of food technology and nutrition is a lengthy one. The investigations have been deep and exhaustive, and the studies of nutrition by McCollum of Johns Hopkins, and by Osborne and Mendel of Yale, developed the surprising fact that foods of approximately similar calorific value and total content of carbohydrates, fat, and protein showed a great variation in their ability to maintain life and promote growth. Some food-stuffs produced results in growth and development of healthy tissue out of all proportion to that produced on the basis of the calorific estimate. The calory's right to supremacy was being challenged; a mysterious, subtle spirit was functioning, working tangibly, but itself as yet intangible, destined in a few short years to assert its potent influence throughout the entire field of food economics, and in medicine to indicate the rational treatment of the dreaded diseases pellagra, beri-beri, and scurvy.

It was recognized in 1897 by Eykman that there was something in the outer coating of the rice kernel, removed in polishing the grain, that had a beneficial action on the neuritis of chickens fed on a diet of polished rice. Ten years later Fraser and Stanton in

the Philippines, experimenting with an alcoholic solution of these polishings, demonstrated that it would cure neuritis induced by the same means.

Casimir Funk was the first to perceive the significant fact that the diseases of malnutrition were due to a lack of some element. His thesis carried the idea that theretofore disease had been attributed to the addition of something foreign to the system. It was an additive condition. But here were conditions caused by the lack of something vital. In contrast to the majority of pathological manifestations, the malnutrition diseases were due, not to additive agents, bacteria, parasites, or contagia, but to a want of certain essential elements required by the system to maintain a condition of perfect health. He experimented with rice polishings and yeast, found that both substances acted favorably on neuritis in birds and on beri-beri in man; and in 1911 he called the essential elements "vitamines."

It was the search for the cause of beri-beri that brought about the discovery of vitamines. This insidious disease has been the scourge of the Orient since remote antiquity. It appears to exist in several forms not yet fully differentiated, but apparently belonging to the same group. It is primarily a disorganization of the nervous system featured by a so-called polyneuritis, swelling of the lower limbs and a weak heart action. Some forms exhibit symptoms often accompanying scurvy, another malady that for years has been surrounded by mystery. The damage to the nervous system caused by beri-beri is often so severe that, even if the sufferer recovers, he lives the life of

a partial paralytic. Sometimes the disease may be so acute that it is fatal within a few days; again, it may develop into a chronic course.

The fact that beri-beri is most prevalent among the populations that subsist chiefly on a diet of rice directed the attention of Occidental investigators to a study of the problem from that angle shortly after the Spanish war, when our country became an active factor in Eastern affairs. The occurrence of the disease was attributed to the eating of polished rice, though the reasons were not clear. It was soon manifestly patent that, given a diet of whole rice, there was no beri-beri. This was an advance in the solution of the problem, and the discovery was important enough to warrant the consideration of the Medical Corps of our army, then campaigning in the Philippines, which promptly gave orders that when rations of rice were dispensed to the soldiers, the meal should always include an equivalent amount of the polishings.

At this point it is in order to explain how rice is prepared for the trade. Rice is a grain with a kernel and husk, and resembles wheat or rye or oats when threshed. Covering the kernel is a closely adhering skin, called the pericarp, dark in color, which from time immemorial has been removed by some abrasive method. The rice kernel, thus denuded of its immediate outer covering, becomes attractive to the eye, with its pearly color and luster, and is preferred by the consumer to the rather unsightly unpolished grain.

When it was observed that a combination diet of rice and its polishings was antagonistic to the onset of beri-beri, the next step was to place the investigations

on a laboratory basis. The subjects for this work were naturally domestic fowl and pigeons, due to their graminiverous tendencies, to which a diet of rice was simply a substitution in place of corn and wheat. The birds, when fed exclusively on polished rice, soon develop typical cases of poly-neuritis, to which they rapidly succumb if not treated in time. The first manifestation is a loss in weight, soon accompanied by a languidness and general malaise. As the severity of the condition progresses, the limbs begin to weaken, until finally they cease to render any support at all. Complete inertia then results, which is the final stage of the disease. And right here the miracle occurs; for if these birds, apparently at the point of death, are made to take a dose of rice polishings or an alchoholic extract of the pericarp, resuscitation occurs as if by magic, and within a short space of time they revive sufficiently to walk around, so that by the next day or so they will be back on their perches, enjoying a hearty meal, as if nothing had happened.

When it became apparent that this wonderful phenomenon was not an accident that happened now and then, but an unfailing influence that could be relied upon when the experiments were repeated over and over again, the desire to isolate the active agent became keen. Enthusiastic investigators entered the field and the activity became widespread. After Casimir Funk had coined the name "vitamine," and demonstrated that the same antineuritic effects existed in yeast that were demonstrated by rice polishings, Seidell instituted a series of researches in the hope of obtaining a relatively concentrated form of this inter-

esting substance, whatever it was. In all the attempts that previously had been made to isolate vitamines in sufficient quantities for experimental studies, only very small yields had been obtained, due no doubt to the destruction of the physiologically active substances in the various steps of the manipulation.

Seidell used brewer's yeast for the basis of his experiments. When this substance, as it comes from the brewery, is incubated at a temperature of about 100° Fahrenheit for two days, it is converted into a thick purée, or, in the language of the chemist, autolyzed. A dark red-brown, relatively clear liquid can be filtered away from the insoluble matter, and this is exceedingly rich in vitamines and has good keeping qualities. If a pigeon is kept on a polished rice diet, without the yeast filtrate, it begins to lose weight in about five days, and will die with a typical paralysis of poly-neuritis within three weeks. But if fifteen drops of yeast filtrate are given to completely paralyzed pigeons, a relief of the paralysis will occur within an hour, and to all outward appearances the pigeon will be restored to a normal condition within twelve hours.

Seidell realized that, though this yeast liquor was swimming with vitamines, when compared with other vitamine-containing substances, it was not sufficiently strong in its restorative powers for practical use as a medicine in treating cases of malnutrition diseases. He set about to find a way to concentrate these mysterious bodies, and finally hit upon a very ingenious process, which yielded not only a highly active but a

permanently stable product. His method was very simple, being based on some observations previously announced by John Uri Lloyd. The latter, who is now one of our venerated patriarchs in the profession of pharmacy and medicine, has made many discoveries of importance and practical value, one of which was that special forms of clay possessed the property of selective adsorption of alkaloids from complex mixtures. On separating the clay from the bulk of the mixture the alkaloids were retained and could be recovered in a remarkably pure condition. Alkaloids, as we have noted in an earlier chapter, are complex organic bodies consisting of carbon, hydrogen, nitrogen, and usually oxygen. Nitrogen is always a characteristic element. Representative of the group are quinin, morphin, and strychnin.

Seidell had gathered the idea that vitamines were perhaps nitrogen-containing substances, and would perhaps act on Professor Lloyd's clay after the manner of the alkaloids. So he tested out his theory, and found that, by agitating the yeast filtrate in the presence of the clay, he could remove all of the vitamines from the solution. He was able to get a product four times as strong in vitamines as the yeast liquor.

Both preventive and curative experiments on pigeons have been made with this material, and the results agree with those made with the solution. It has been found that prompt and effective cures of completely paralyzed pigeons result from $1/20$-gram doses of the activated solid. Preventive experiments, continued for more than a month, using $1/20$ of a gram on

alternate days, showed that the pigeon retains its normal health and weight on an exclusive diet of polished rice.

The possibilities of this activated solid as a remedial agent for treating diseases of malnutrition must be apparent to anyone. Its advent is one of the high points in vitamine history. Being a permanent substance and easy to manipulate, it can be introduced into gelatin capsules or molded in the form of tablets, thus providing a concentrated form of the life-giving agents, which the physician can administer in any dosage he desires. It can be mixed with malted milk or any other special food for the chronic invalid or the convalescent. Being virtually tasteless and not unpalatable, it can be included with the daily ration and fed to anemic children. To the indigent population of our Southern districts, where pellagra is prevalent, its use as a preventive and cure of the insidious malady should prove of incalculable value. Its potency may be determined by laboratory methods, and altogether it furnishes the most dependable means of supplying vitamines wherever the indications point to their need in cases of illness. Seidell patented his process and then gave the invention to the public.

The vital principle obtained from yeast and rice polishings is only one of the group to which the name vitamines has been given. It is called "water-soluble B." There are two others now generally recognized as members of the family, called "fat soluble A" and "water soluble C."

Brewer's yeast is conceded by all to be the richest in vitamines of any substance yet examined. More

work has been done on water soluble B than on any other, and it is now suggested that it may consist, not of a single acting body, but of at least two, differing in their mode of action toward poly-neuritis and toward supporting and developing healthy growth.

It is surprising that the brewing industry failed to make the presence of vitamines in beer a potent argument for the retention of this commodity in the economic life of the nation. Attempts were made to prove that beer had food value, but they carried little weight to the minds of those hostile to the beverage because it contained a little alcohol. Why the value of beer as a ready means for supplying these all-important nutritional substances was not urged upon our lawmakers as a reason for not prohibiting its manufacture and sale is beyond comprehension. The brewers lost the chance of a life-time. They could have employed a vital argument to bolster up the one-sided fight.

Water soluble B is the vitamine that is present in spinach, cabbage, potatoes, carrots, turnips, beets, onions, and tomatoes, and in the juice of such fruit as oranges, lemons, and grapefruit. The importance of these foods in the diet is thus apparent. Their lack of calorific value no longer possesses any significance. They are just as necessary in the general scheme of nutrition as are those foods of high protein, fat, and carbohydrate content.

Fresh fruits, green vegetables, and fresh milk contain the other water soluble vitamine. This body is antagonistic to the conditions characterizing the dreaded disease scurvy, and anything of this nature

is called "antiscorbutic." Hence water soluble C is the antiscorbutic vitamine. Scurvy is usually associated with the old sailing days, when whaling-vessels made long voyages without touching shore, or when explorers fought their way for months and years amid arctic wastes. Its virtual absence among sailors who partook freely of fruit juices began to attract attention more than a century ago, and later the British made lime-juice a regular ration in the Navy, with the result that there have been very few, if any, serious outbreaks of scurvy among their seamen since 1795. It is a mistake to consider scurvy a disease accompanying a seafaring life, for it will occur just as readily among people who have never been to sea and whose occupations are entirely terrestrial. Outbreaks have occurred among bodies of troops engaged in land operations, while infantile scurvy is common where the use of pasteurized milk is not accompanied by a sufficient quanity of fresh orange-juice to supply the antiscorbutic vitamine that is lost when the milk is heated.

Water soluble C is very easily destroyed; hence most fresh vegetables and fruits, when cooked, lose their antiscorbutic effect. The significance of this fact is cause for reflection when one realizes how extensive is the use of canned vegetables and fruits in our modern system of living. Fortunately, the bulk of our population partake of a varied bill of fare which includes a goodly proportion of energizing cereals, meat, butter, fresh vegetables, raw milk, and fresh fruit. They get, therefore, a sufficient supply of vitamines to maintain the nutritive processes, as well as enough combustible material to combat fatigue, thus

enabling them to perform their daily occupations.

It is among those people whose food supply consists of a limited variety, or of no variety at all, that the lack of vitamines becomes a menace to the general health. Take, for example, the prevalence of infantile scurvy and rickets among poor children and those whose guardians have mistaken ideas about the regimen of infant feeding. It is folly to sterilize all foods and drinks to the point that no life-maintaining elements are left to function.

Probably the most widespread condition prevalent in this country due to malnutrition is the insidious pellagra, a disease associated with the indigent population of the Southern States east of the Mississippi. Pellagra is definitely related to diet deficiency. It had been recognized in Europe before it was described in the United States, but it has undoubtedly existed here for a long time. Unsanitary and unhygienic living conditions, combined with a monotonous diet void of lean fresh meat, milk, eggs, fresh vegetables, and fruit, are contributive causes to its development. It is manifested in the beginning by the appearance of dry, rough patches on the skin, and it is due to this condition that the disease became known as pellagra (rough skin). Later the stomach and bowels become involved, leading to indigestion and diarrhea; soreness of the mouth develops, and the gums begin to bleed. In time the entire nervous system becomes affected, the activity of the brain impaired, tremors suggestive of St. Vitus's dance shake the body, while the sufferer becomes mentally unbalanced and irresponsible.

Studies made by the Public Health Service in the

pellagra districts demonstrated that for a considerable time there has been a gradual diminution in the vitamine content of the diet of the population. The conditions are the worst during periods of economic depression, especially when the cotton crop fails or is unprofitable. Most of the people affected are improvident, leading at best, a hand-to-mouth existence, and when they are unable to realize on the chief staple of the South, either through their own efforts or by assisting others, the wherewithal to purchase fresh meat, vegetables, milk, eggs, and fruit is lacking, and they fall back on highly milled cereals lacking the vitamine-containing germ and pericarp. They use little yeast in raising their bread, but depend upon soda, which not only is not a source of vitamines, as yeast is, but tends to destroy any of those vital substances still present in the grain.

The well kept kitchen-gardens, with their profusion of lettuce, cabbages, spinach, beets, peas, carrots, and the like, characteristic of the Northern sections, are not features of the small farms of the South. There it is corn and cotton, cotton and corn, with perhaps a cow, a few pigs, and a flock of chickens in times of affluence. But when living costs advance, and the cotton crop fails, the cows and the pigs have to go, the eggs bring too much at the store to be sacrificed for the home table, and corn bread and potatoes become the basis of sustenance. Butter, the source of certain vitamines (fat soluble A) about which we shall hear later, is a luxury seldom enjoyed even in times of comparative affluence. Fresh fruits, with the exception of berries in the short season when the wild

crop is available, and watermelons when the dusky denizens of the neighborhood have been prevented from rifling the patch, seldom have a place in the menu. The peach crop is usually gathered and sent to the cities or to the canneries. The influence of the lack of a mixed ration is manifest among these people even when work is plenty; but when hard times come —and in some localities it looks as if hard times were the rule instead of the exception—the variety in diet is supplanted by a monotonous menu lacking in the life-sustaining and body-building vitamines, so that by springtime the insidious pellagra has obtained a strong foothold in the community.

Any one familiar with Southern conditions could have predicted in the fall of 1920 that there would be widespread suffering from pellagra in the spring, or at least by the beginning of the summer of 1921. The South was hit as hard economically after the armistice as any other section of the country. The cotton crop of 1920 was in large measure allowed to remain unpicked because the price of the commodity was so low that it was unprofitable to pay the cost of the labor to gather it. This meant a loss to the small grower as well as to the laborer. In the late fall many farms were sequestered on account of debt, and the poorer element generally faced a winter of hardship and poverty. The health of the people, which had been stimulated by the accompaniment of the general superficial prosperity brought about by war conditions when wages were sufficient to enable them to maintain a nutritious bill of fare, was able to withstand the weakening influence of the deficient diet through the

winter; but by spring the less robust began to give way, and by summer-time the epidemic was well under way.

In recent years pellagra has become a menace of national concern, and to combat it the aid of the Public Health Service has been enlisted. If the sufferers can be subjected to suitable dietary treatment, the disease can be controlled; but this is difficult, except in communities where hospital assemblage is possible. Proper handling of outlying cases through a dietary régime is impossible. The psychology of the average "poor white" and indigent black of the South, little understood by any one outside of that section, is not deep enough to understand the significance of treating a diseased condition with food that they have not got and that, if they did have, they would not know how to prepare. It is a fine thing to advise people what to eat and how to prepare it for the table; but, as we have observed in an earlier chapter, the intelligent and highly educated population of our country will not become dietitians within the next fifty years at least, so it is folly to expect more from those who are lower in the social scale. Furthermore, if circumstances are such that these people are unable to afford proper kinds of nourishment, there is little to be gained in advising them to get them and letting it go at that.

Why the employment of Seidell's activated solid, unquestionably a remedy for these diseases of malnutrition, has been overlooked as an adjunct in handling the pellagra situation, it is difficult to fathom. It would seem that, in view of the peculiar conditions ob-

taining in the pellagra districts, a rational combination of diet, as far as it is possible to direct it, with the employment of a remedial agent known to be rich in vitamines, would be the apparent course to pursue.[1]

We have yet to discuss the third body of the vitamine group, known as fat soluble A. It occurs in raw fresh milk, butter, animal fats, and fresh green leaves and grass. When lacking in the diet of infants, it is one of the contributing causes to the condition known as rickets. Though it is found in animal fats, it is of vegetable origin, and the character of the food of the animal determines its presence. Dried alfalfa, clover, timothy-grass, spinach, and tomatoes are rich sources of vitamines A. Yellow corn, carrots, and sweet potatoes also contain life-sustaining quantities. Milk and butter are not necessarily of high nutritional value. If the cattle are able to graze on a pasturage rich in clover and good grass, and in winter are fed timothy or alfalfa hay, the raw fresh milk should be rich in vitamine A.

Cod-liver oil probably owes a part of its universal reputation to its content of fat soluble A vitamine. It has been a popular remedy for decades, being administered in the pure state and in various combinations, one of which, Scott's Emulsion, is one of our most widely known family medicines.

The fact that cod-liver oil possesses valuable prop-

[1] As a result of recent studies as yet unreported, it would appear that it may be necessary for us to modify our views concerning the cause of pellagra. But, in any event, it has been granted that the onset and progress of the disease are dependent upon the character of the food supply, and whether or not the lack of vitamines, or perhaps something in the nature of a super-vitamine, is primarily responsible, is a question that must be subjected to further research.

erties as a reconstructive agent, perhaps more so than any other fixed oil, has attracted the attention of investigators for many years. The researches have been voluminous, and in the aggregate no less than a hundred different substances have been reported as taking part in its composition. Its virtues have been attributed to iodin, phosphorus, nitrogenous substances, alkaloids, and many others, and altogether the chemistry of the subject has become considerably involved and confusing. This is due, in a large measure, to the fact that there is more than one grade of cod-liver oil. One group of scientists has worked on one grade, another on an oil of an entirely different type, while all have reported their findings on cod-liver oil without qualifying what kind it was or how pure.

There are two kinds of commercial oil, and to understand their difference it is necessary to describe the methods obtaining in the fishing industry from which they are derived. When the codfish are brought in, they are cleaned, the livers being stripped and separated from the rest of the entrails. The livers are thrown into casks, which are either taken directly to the presses, or allowed to remain for a while until enough have been collected to remove to the factory. Those that are pressed immediately yield a clear pale-yellow oil of high quality, the kind used for making high-grade emulsions or for direct consumption by the patient, either in capsules or by the tablespoon. The livers that are not pressed immediately soon begin to putrefy; the complex nitrogenous compounds are broken down into simpler substances, some of which are known as amines. These dissolve in the oil, and

later, when the oil is recovered, it is dark brown in color, highly odorous, and exceedingly distasteful. Such an oil is never dispensed directly as a medicine, but is used for working up the vast number of cod-liver extract compounds so widely advertised. Sometimes the partially putrefied livers, with their full content of oil, are employed for working up these preparations, but the results obtained are for all intents and purposes the same.

In view of this situation, it is no wonder that there has been much confusion concerning the chemistry and therapy of cod-liver oil. It is not clear in the scientific world, outside of a comparatively small number of workers who have gone deeply into pharmaceutical chemistry. Pure cod-liver oil pressed from fresh livers is a readily assimilable fat rich in vitamines. It owes its virtue to the latter, and to the fact that, as it is comparatively easily broken down in the intestines, where fats are digested, it provides an abundant supply of energizing material, and in some cases will add to the weight of the individual who is lacking in the proper complement of fat. The special mixtures prepared from the dark-colored oils or the livers themselves contain little or none of the real oil, and to what extent the nitrogenous bodies act favorably on the human system has never been satisfactorily demonstrated. They may contain the full vitamine content of the pure oils, but this, too, is still a matter of conjecture.

The source of the fat soluble vitamine A present in cod-liver oil is an interesting subject for speculation. It would appear that vitamines are synthesized only

in the economy of vegetable growths, and that their presence in animal products depends on the diet of the animal. In fact, it is a question of timely interest among scientists whether fat or merely fat-soluble vitamine is necessary in the diet. Osborne and Mendel have fed rats on a diet almost free from true fats, making use of dried alfalfa with its high content of vitamine A, and balancing the ration with yeast, starch, meat residues, and salt. The subjects thrived on the fare, from which they observe, "If true fats are essential for nutrition during growth, the minimum necessary must be very small." How far this might apply to tigers and to men who normally are not herbivorously inclined, is still a potential subject for investigation. But, coming back to the codfish, we must alter our ideas regarding the nature of the food of fishes in general, and, instead of considering the cod as a ravenous consumer of the smaller fry of the ocean, place him in the status of a placid sea-grazer.

The study of vitamines has progressed in the direction of their application to food economy and nutrition, rather than to their importance as therapeutic agents. The knowledge gained concerning their significance to the food requirements of the individual has shown that a balanced ration is essential to health and growth. The diet should be constructed with due regard for water, mineral salts, fat, carbohydrates, proteins, and vitamines. In handling the pellagra situation, emphasis has been placed on the food supply and diet for relieving the basic causes of the disease, leaving to medicine the treatment of acute and symptomatic conditions. Little attention has been given

to the possibilities of vitamine-therapy and the use of remedial agents such as Seidell's activated solid. As time goes on it is probable that substances of this nature will come into vogue and receive the recognition that is due them. Dr. Wiley, in a recent interview, summarized tersely his conception of the chemistry of nutrition as follows:[2]

> In the last twenty-five years the chemistry of nutrition has become revolutionized. Prior to that time the science of nutrition was more or less empirical. At the present time it is very rigidly scientific. The outstanding facts of this progress are found in the discovery and identification of amino-acids, the building-stones of the body. Coupled with this has been the discovery and partial identification of the properties of the so-called vitamines. Absolutely pure foods—that is, pure sugar, pure starch, pure protein, pure fat, and pure mineral substances—are incapable of nourishing the body. There must be present the vital spark, that is, the vitamine. If I might compare the human body to a motor-car, I would say that the food represents the gasoline and the vitamine the spark. It requires the two to drive a car; so it requires food and vitamines to drive the human or other animal organism.

Returning for a moment to the conception of dietary requirements on the basis of calorific value, we will refer to the work of Emerson, who, as a result of his researches on nutrition, believes that every individual requires sufficient calories to keep his weight at a point normal for him. "Normal" is usually the weight at which he feels best. If underweight, from 2000 to 4000 calories are necessary to cause him to

[2] Drug and Chemical Markets. IX, 1921, p. 512.

gain, when continuing his usual work, provided he has proper rest. If the individual is overweight, reducing the calories to 1600 or 1200 will usually cause him to lose. When normal weight is attained in an adult, from 1800 to 2400 calories are usually sufficient to maintain it.

Emerson has calculated the quantity of calories yielded by all of the ordinary foods. He finds, for example, that 100 calories are obtained from each of one lamb chop, four sardines, one pat of butter, twenty-one ounces or four heaping tablespoons of boiled spinach, four average fresh tomatoes, and one apple. Five ounces of cow's milk or one ounce of top cream produce 100 calories.

In the usual varied diet the vitamine essential is ordinarily present in sufficient quantity to prevent under-nutrition. But if this feature is lacking in the diet, no amount of calories produced will maintain a healthy condition.

Rosenau [3] finds that milk is rich in all three vitamines:

> It is usually rich in fat soluble A, contains an abundant amount of water soluble B, and a variable but ordinarily sufficient quantity of antiscorbutic vitamine. Therefore it protects against all of the known deficiency diseases. It has long been known that the effect of heat on vitamines varies with the reaction and other factors. Most vitamines are more readily affected by heat in an alkaline medium than in an acid one. Fortunately, most foods are acid. Milk is acid from the time it leaves the udder. With regard to the effect of heat upon the antiscorbutic vitamine, it has been shown that the duration of the heating process is of greater

[3] Boston Medical and Surgical Journal, May 5, 1921, p. 455.

importance than the degree of temperature to which the food is subjected. Dry milk may retain its antiscorbutic virtue in spite of drying, canning, and aging, especially if well packed and hermetically sealed. It loses its potency after it is exposed to the air. Canned milks and dried milks, then, retain the fat soluble A and water soluble B vitamines in almost their original potency. The only vitamine in these preparations that may be affected is the antiscorbutic vitamine.

Of the physical character of vitamines we know very little as yet. That they are individuals we are reasonably certain, but they have never been separated in a state of purity sufficient for their identity. Seidell and Williams, from their work on water-soluble B, have determined that it belongs to the series of organic substances, and that it is probably very complex in its make-up. Seidell succeeded in preparing a vitamine compound possessing the characteristic active properties of the vitamine. When he endeavored to separate the vitamine in order that he might study it in a state of purity, a substance was obtained having none of the life-sustaining characteristics that had accompanied the mixture down to the point of separation. It was like working with a spirit hidden behind a veil, observing the spread of its influence, fascinated by its spell, conversant with it seemingly as with a tangible personality, confidently anticipating and relying on the effect of its actions and then, when the curtain was drawn, to find that the spirit had fled.

But enough is known about these mysterious bodies to enable us to subdue them to such a condition that

they may be handled and made to exert their influence according to our will. The future points the way to their usefulness in some form or other for combating the malnutrition diseases pellagra, beri-beri, and scurvy. They will be concentrated until relatively small doses will produce important results. They will enter largely into the prevention of undernourishment among those populations whose vitality is being reduced by an inadequate and unbalanced diet. In the meantime, the popular interest in vitamines will bring about the introduction in the market of questionable preparations, featuring these substances in one form or another, but carelessly formulated, without regard to their therapeutic adaptability. These will pass on, and the legitimate stable vitamine concentrates, representative of all three forms, will take their place.

The time will come when the medical supplies of the armies and navies of the world will number among their indispensable essentials vitamine-containing products, prepared with due regard to their content of the three essential vitamines, conveniently packed and readily available. They will be rationed among the troops whenever the food supply becomes unbalanced or when evidences of malnutrition begin to appear. The Red Cross and other agencies engaged in relief work among the prison camps and refugees will find abundant opportunity for the dispensation of preparations of this character. In fact, in the great problem of adequately caring for the welfare of large congregations assembled under abnormal conditions, vitamines are likely to play just as important a part as other remedies; for example: quinin, on which

dependence is placed for treating malaria and certain forms of tropical fevers.

Concentrated forms of vitamine will be featured in the commissary stores of the maritime trade, especially in the case of sailing-vessels making long voyages and out of touch with civilization for long periods. Explorers, outfitting for their journeys into the vast jungle wastes, the limitless steppes lacking the resources of vegetable and animal life, the bald mountain districts where life and energy are under continuous challenge, or the lonely and sunless polar ice-fields, where tension and nerve-racking strain are never absent, will in the same way equip themselves against nutrition deficiency with the same forethought that they provide for defense against savage animals and hostile tribes.

In fact, when vitamines come into their own, and receive the appreciation due them, their importance as adjuncts in prophylaxis and the treatment of disease will carry the same appeal to the medical profession that their nutritional rôle now carries to the food economist.

CHAPTER X

DOPE AND NOT DOPE

In the non-professional world the expressions "dope," "dope habit," and "dope-user" have a variety of meanings. Almost always something of a repulsive and insidious nature is comprehended, and usually, though not always, the term is associated with the use of drugs. In fact, to some persons the words "drug" and "dope" are virtually synonymous.

If a food or beverage produces unusual effects on the consumer, it is customary to speak of it as having been "doped"; in fact, one of the favorite soft drinks, differing in composition from the usual run of pops and sodas sold at the fountain, is in some localities called for simply by the name "dope."

To the public at large the associations above referred to have become so attached to the word, and it has been used so indiscriminately and with such general application, that its original meaning has become obscured. In its inception dope meant any thick, viscous liquid or semi-fluid; and when, during the war, this name was applied to the preparations used for coating the cloth of the wings of airplanes, it was thought by many to be a slang expression, when really it was a correct term according to the definition in the dictionary. "Dope," in the vocabulary of slang, is conceded to refer to a narcotic drug,

though the verb may mean either to stupefy or to exhilarate.

A narcotic is something having the power to produce stupor. It is a substance that directly induces sleep, allaying sensibility and obliterating the senses, and in large[1] quantities producing narcotism or complete insensibility.

Now, the evil associated with the use of narcotic drugs is the habit acquired thereby. But not all narcotic drugs are habit-forming; and some of the habit-forming drugs commonly referred to as narcotics or dope are not narcotic in a medical sense. Before going further, therefore, let us define what is understood by the term "habit-forming" or "habit acquirement." This has been very tersely explained by Mallet[2] as implying three things. In the first place, the habit formed is both detrimental and injurious; in the second place, it is one that becomes so firmly fixed upon the person acquiring it that it is thrown off with great difficulty and with considerable suffering; and, in the third place, the continual exercise of the habit increases the demand for the habit-forming agent.

A consideration of the dope habit and its attendant evils is really limited to opium, its preparations and habit-forming alkaloids, and to coca leaves, their preparations and habit-forming alkaloids. Many other drugs are looked upon in some quarters as falling into the class of habit-forming agents. Some of these

[1] Century Dictionary.

[2] Testimony United States *vs.* 40 Barrels and 20 kegs Coca Cola. District Court of United States, Southern Division, Eastern District of Tennessee, 1911.

are narcotic in their action, while others manifest physiological effects entirely opposite to narcosis. Indulgence in the use of tobacco, even, produces a form of narcosis, it is claimed by a firmly intrenched coterie of agitators.

Referring to some of the more commonly occurring drugs and medicinal preparations, we find that among those exhibiting properties included within the definition of narcotic are opium preparations made directly from the crude drug, such as laudanum, paregoric, Dover's powder, Black drop (not Black draught, which is a harmless liver remedy), Bateman's Pectoral Drops, Dalby's Carminative, and smoking opium; the pure alkaloids, morphin and codein, and their salts; and heroin, a derivative substance artificially made from morphin. Included in the list of narcotics we find also coca leaves and their chief alkaloid, cocain, though it should be noted, in passing, that the characteristic manifestation of these products is primarily one of exhilaration or stimulation.

Hyoscin or scopolamin, a powerful substance occurring in the leaves of henbane and the root of scopola, possesses the characteristics of a narcotic. It is the drug employed to induce the "twilight sleep" that allays the suffering incident to childbirth, and is also one of the remedies depended upon by the practitioner in the systematic treatment of alcoholism and the morphin habit.

Alcohol falls within the category of narcotic agents. Its physiological action is to a large extent misunderstood in the popular estimation; for, instead of being a true stimulant to the brain or nerves, its dominant

influence is that of a depressant. To quote Hare:[3]

> The increased activity of thought and speech after its use is not due to stimulation, but to depression of the inhibitory nervous apparatus. The activity is therefore that caused by lack of control, and is not a real increase in energy. So far as the brain is concerned, it does not increase the vigor of thought nor its depth, nor does it enable a man to work out a problem which is difficult. On the contrary, it rather benumbs the activity of mental processes. The effect of moderate doses differs from the effect of large ones in degree, but not in kind. . . . In large doses it produces lack of coördination by depression of the brain and lower nervous system, the loss of coördination being due largely to impairment of sensation, so that the sense of touch and the muscle sense are interfered with. This effect makes a drunken man fail to recognize the angles or uneven surface of surrounding objects, and the impaired mental power and disordered judgment, combined with the imperfectly acting motor and sensory pathways, cause him to stumble and fall.

Cannabis, while possessing the elements of a narcotic, is perhaps more of an analgesic or reliever of pain. Its primary effect is exhilarating, and in large amounts only is it subsequently hypnotic, which means that it produces sleep, a necessary requirement of a true narcotic.

Chloretone, a comparatively recent introduction to the materia medica, has a sedative action on the nervous system, with accompanying hypnosis. It differs from chloral, a true hypnotic, in lacking the objectionable quality of the latter, namely, depression of the heart action and breathing. It has been successfully employed as a remedy for seasickness.

[3] "Practical Therapeutics," 1916, p. 76.

Having referred to hypnotics, it is in order at this point to discuss the two notable members of this class of medicinal agents, chloral and veronal. Hypnotics that are used to produce sleep are divided into two groups, the first causing slumber alone, and the second producing sleep and at the same time relieving pain. The two drugs above mentioned are the conspicuous examples of the first classification, while of the latter, which are more strictly speaking narcotics, opium and its derivatives are representative. Examples of addiction to the use of chloral are on record, and no doubt it falls properly within the category of habit-forming drugs. When properly administered however, its use is attended with little danger, and it is within the realm of probability that much of the odium attached to its name is due to the knowledge of its employment for criminal purposes. Veronal is a comparatively safe hypnotic of somewhat recent introduction. It is a synthetic drug differing entirely from chloral in its make-up. Chemically it is diethylbarbituric acid, and is built up on the urea molecule, the latter substance being a constant constituent of the human organism, produced during the metabolic processes and forming the chief solid constituent of the urine. A salt of veronal, veronal sodium, known also as *medinal,* is readily soluble in water, and is a very satisfactory product for exhibiting its properties.

Among the other important nerve sedatives that possess more or less hypnotic influence are the bromides and sulphonal. The bromides are mineral salts, and should not be confused with the opiates. Their

use in moderation is attended with no special danger, but their habitual use to relieve painful and nervous symptoms when the cause of the manifestation is obscure is demoralizing. Hare[4] describes the effects of the prolonged use of bromides, known as brominism, as follows:

After the drug has been used for some time in large doses, acne appears about the face and extends over the entire body; the breath becomes fetid, the patient is dull, expressionless, and heavy, and remains buried in sleep during nearly every hour of the day. During this time he can be aroused, but at once sinks to sleep again. The gait becomes weak and feeble, the movements slow and prolonged. Taste is lost and hearing is benumbed, while the intellectual faculties of the brain are almost in abeyance. Loss of sexual power is an early symptom. In other cases evidences of mental aberration develop, the patient becoming irritable, morose, and even homicidal. Sometimes, however, we find melancholia and hallucinations, and rarely exalted ideas with symptoms resembling general paresis.

Sulphonal is a stronger hypnotic than are the bromides, and has the advantage over chloral in not being depressant to the heart. Its elimination is slow, however, and its use, if persisted in, brings about a general disturbance of the system, accompanied by drowsiness, unsteadiness of gait, and partial paralysis of the lower extremities. Habitual use develops a condition of chronic poisoning, accompanying which the addict may lapse into profound unconsciousness, ending in death through respiratory failure.

We now come to a list of miscellaneous drugs pos-

[4] Op. cit. 147.

sessing a sedative influence on the nerves, but which ordinarily are not considered hypnotics. They are acetanilid, amyl-nitrite, antipyrin, asafetida, aspirin, belladonna, camphor, chloroform, cimicifuga (black cohosh), ether, Hoffmann's anodyne, hops, mescal, phenacetin, and valerian. While there is a similarity in their action on the nervous system of a greater or lesser degree, their effect on the other bodily organs and processes may be extremely varied. Some of these remedies are credited with being subject to habitual use; but the effect of some of them, except in abnormal instances, cannot be compared with the usual accompaniments of the addiction to the opiates and cocain.

We hear occasionally of "ether-lappers," who appear to be as enslaved to the ether habit as do chronic inebriates. The sordid appearance of these unfortunate addicts was vividly portrayed a few years ago in the character of "Madam X." Chloroform, employed as an hypnotic, may lead to the acquirement of an addiction, the course of which is usually of short duration, ending in the death of the unfortunate. Chloroform has a peculiar effect on the circulatory system in that, by causing a condition of relaxation, the blood is allowed to enter the areas surrounding the network of veins, and not enough goes through the heart to maintain the vital processes. It is as if the impounding works of a reservoir should suddenly become elastic and spread out, allowing the water to flood the neighborhood. The world is not likely to become diffused with an extensive population of chloroform addicts, because sooner or later the habitual use of the

drug results in an accident from which there is no recovery.

The four analgesics antipyrin, acetanilid, phenacetin, and aspirin have, at one time or another, been subject to more extensive consumption than almost any other class of remedies. Antipyrin has little vogue at present, but aspirin has come into prominence in recent years and enjoys phenomenal popularity as a remedial agent. None of the remedies are narcotic in their action and they cannot be classed with the group of "dopes." The undue and prolonged use of any of them may be deleterious to the consumer, but a somewhat widespread popular notion that "coal-tar" products are always dangerous is unwarranted.

In their inception antipyrin, acetanilid, and phenacetin were used for reducing fever, but as the knowledge of their efficacy for relieving pain became widespread, the ease with which they could be administered led to their adoption as a means for combating headache, and hence their use is inseparably associated with remedies for that disorder. Aspirin is a salicylic-acid derivative, less complex in its structure than the other antipyretics, and was originally offered to take the place of salicylates in the treatment of rheumatism. It was found to have a beneficial effect on neuralgia too, and later came into general use as a headache remedy.

Some years ago Kebler, Morgan and Rupp [5] collected a series of data on the harmful effects of antipyrin, acetanilid, and phenacetin, drawing their ma-

[5] United States Department of Agriculture, Bureau of Chemistry, Bulletin 126; Farmers' Bulletin 377.

terial from the experiences reported by some four hundred physicians. The figures showed that, with antipyrin and phenacetin, most of the cases where deleterious conditions were observed occurred in the early years of their administration, and thereafter only a nominal number of instances were recorded. Acetanilid followed a similar course until 1904, after which time there was a slight increase in the cases of reputed poisoning. A few instances of habitual use were cited, but, considering the universal and indiscriminate consumption of these drugs, the proportionately meager cases of addiction, when contrasted with the situation with respect to the opiates, need cause little concern.

The habitual dependency of any individual on the remedies that we have thus briefly discussed, for the relief of abnormal conditions, whether or not the drugs themselves are credited with being habit-forming in the sense of Mallet's definition, is not to be commended. If the ailment is of a constantly recurring character, professional advice should be sought, so that the seat of the trouble may be located and steps taken to cure it. Hypnotics and nerve sedatives have their place for relieving the ills to which mankind is susceptible, but they should not be relied upon indefinitely to relieve the symptoms of some more obscure pathological condition, any more than should the individual depend upon the administration of a laxative drug to bring about a daily evacuation of the bowels.

There is a tendency to jump at hasty conclusions whenever there are reports of an accident due to the taking of some drug. When subjected to unbiased

investigation, these stories are often found to be based on incorrect information, both as to the character of the drug and the condition of the user. Closer scrutiny often reveals the fact that the user has an ax to grind or that his condition is primarily induced by abuse of some character or other. Even the nature of the drug under condemnation may be erroneously heralded, a situation that occurs in scientific literature as well as in the daily press. At the time of the Coca Cola trial, citation was made of certain deaths from caffein reported in the medical journals; but a critical study of the articles revealed the fact that either the drugs under consideration were not caffein, or the mortality was due to causes other than the caffein.

There is danger of placing too great credence in the reports of the habitual use of drugs. Investigation frequently reveals that the information is worthless. For example, in assembling data for a compilation of the extent of the opium and cocain habit, one of the reviewers asked a reporter how he became acquainted with the fact that there were six hundred cases within his jurisdiction. The reporter replied that he knew of six cases, but that if he turned in such a small number his report would look ridiculous, so he multiplied the figure by one hundred. Again at the time of the Coca Cola trial, the government agents sought to gather evidence that the drink was habit-forming. Plenty of information was freely offered to show that such was the case; but when it was attempted to run down concrete examples, or to obtain the evidence under oath, the investigators ran up against a blank

wall. A physician finally went on the witness-stand to testify that he had under treatment three Coca Cola habitues; but before cross-examination, and between sessions of the court, he withdrew his testimony and was heard of no more. Thus far an authentic Cola Cola fiend is as great a myth and as hard to locate as Eben Holden's "swift."

In most of the headache remedies featuring antipyrin, acetanilid, or phenacetin, the analgesic drug is usually combined with caffein and perhaps two or three other ingredients. The caffein is put in for the alleged purpose of counteracting the depressing effect of the coal-tar compound.

At one time a violent controversy raged in the professional world over the question of the habit-forming nature of caffein. The contention was precipitated on account of the rapidly increasing consumption of Coca Cola. When analyzed, the beverage was shown to contain, in the quantity ordinarily dispensed to the consumer, about one grain of caffein, the same proportion that is present in a cup of good tea and about half as much as found in a cup of strong coffee. Elaborate researches were instituted. The study of the properties of caffein received the attention of nearly all the prominent scientists of a decade ago, and never has the physiological action of any other drug been subjected to so exhaustive an inquiry as has that of caffein.

At the Chattanooga trial the life history of caffein was exposed in the minutest detail by the experts, the testimony being of sufficient volume to compile a large text-book; but no one could substantiate the conten-

tion that the drug, when consumed in the dosage noted above, was habit-forming, or that it was essentially deleterious. The testimony of Hare, an experimenter and therapeutist of international prominence, is of interest, since it summarizes the professional conception of the action of caffein on the ordinary individual, and establishes its position in the drug world:

Q. Is the use of caffein as a stimulant followed by depression?

A. It is not.

Q. Is caffein a habit-forming substance?

A. Never.

Q. Does it have any cumulative effect?

A. Not in the slightest degree. . . . Caffein increases the muscular ability to work without producing any secondary depression, and without in any way impairing what has sometimes been called the reserve energy of the muscles. In other words, it has very much the same effect upon the efficiency of muscles as oiling machinery has upon the efficiency of the machinery. It enables them to expend their energy with less effort.

Q. For what purpose is it used as a medicine?

A. As a stimulant to the general nervous system in cases of depression, to improve the action of the heart in persons who are over-fatigued, played out, to increase the activity of the kidneys when the urinary secretion is not as free as it should be, to relieve certain types of headaches and eye-strain.

Q. Is caffein a poison?

A. Not at all.

Q. On what do you base the statement that caffein is not a poison?

A. In the first place, I have administered it in very large

doses without seeing that it produced any symptoms that would justify any one classing it as a poison. . . . In not one case that I have been able to find, where death followed the use of caffein, was there any proof whatever that caffein caused the death, and there were abundant evidences that there were three or four other likely causes of death. In the case of poisoning which did not go to the point of death, the doses were either very, very large or they were poorly reported; and the fact that caffein is found in certain books classed under the head of poisons or with many substances which are ordinarily known as poisons, is of no particular significance. To illustrate what I mean, if you look in the United States census, you will find that chickenpox is classed under infectious diseases with consumption and pneumonia. You will find two hundred thousand deaths from pneumonia and one or two from chickenpox, and if you investigate the cases where the death was reported from chickenpox, you will find they occurred in children so near death by reason of other diseases that anything would have sent them off, and that is the way with caffein when it is quoted as a poison in certain books, in connection with other substances which are poisonous.

The action of caffein is stimulating. It is not a narcotic, nor does it possess hypnotic properties. It is not a dope in any sense of the term. In tea and coffee it is consumed by a large proportion of the inhabitants of the globe, and in these beverages its physiological properties manifest themselves in exactly the same way and to the same degree as when the same relative amount of the drug is administered in what is termed the free state.

It will be noted that the discussion of the topic under consideration has generally been in reverse

order to the title of the chapter. We have referred to a number of drugs with which the public is familiar, either from personal experience or hearsay, and have reserved until the last our treatment of the opiates and cocain. Aside from alcohol, addiction to these drugs overshadows completely the habitual use of all other agents combined, and this in spite of a vast amount of meritorious regulatory and restrictive legislation.

But, before plunging into the consideration of this many-phased subject, we must digress for a short interval to treat of a very interesting commodity known as cannabis. This drug, to which the name of hashish is commonly applied, has incited the interest of the Occidental student for a long period of time. The weird accounts of the gorgeous realms of Elysium to which one is transported when under the spell of its intoxication are full of romance. Hashish has been featured in the lore of the East ever since civilization began to keep a record of its progress. The word *banza*, which appears to be synonymous with hashish, figures in the Indian vocabulary as far back as B. C. 1400. However, it is important that we should develop a clear understanding as to the difference between cannabis, the medicine, and hashish, the Oriental intoxicant.

The name *Cannabis* is generic for the hemp plant, the full botanical designation being *Cannabis sativa*, or the superseded synonym *Cannabis indica*. The botanical individual to which it is applied is the same, whether it is grown in India, Persia, Greece, or the United States, though it may show variations in its

stature and growth. The diversities have been mistaken for distinct species, and have caused much confusion in the drug trade. The variety desirable for producing rope fiber is tall and comparatively sparsely branched, shooting up to a height of fifteen feet or more. That most suitable for yielding the drug has a bushy growth, seldom exceeding ten feet at the top and averaging somewhat less. The species is one of the few in the vegetable kingdom that is bi-sexual; that is, the male blossoms are borne on a plant distinct from the one on which the female flowers appear. For reproduction or the development of viable seeds, both sexes must be present, just as in the animal world it requires the sexual union of the opposite genders to carry out nature's function of perpetuation. In the case of the cannabis the pollen or fertilizing agent secreted by the male plant is received through the medium of the air currents by the open pistillate blossoms of the female.

The branches of the female plant and the smaller subsidiary branchlets develop at their terminals thick clusters of matted flowers, which at full development secrete a sticky greenish resin. These tops, when dried and stripped from the stems, constitute the commercial drug from which all medicinal preparations of cannabis are made. And since it is prescribed in the various drug standards of the world that the blossoms should be unfertilized, it is necessary, when the drug is grown for commerce, to remove the male plants from the field before their flowers expand and the pollen is ready for distribution. When properly prepared, cannabis is a potent and perfectly reliable drug

which may be converted into medicines exhibiting its characteristic physiological properties in permanent form. Though cannabis medicines are used for their sedative action on the nervous system, and for certain purposes may provide satisfactory substitutes for the opiates, many of the unsatisfactory secondary effects attendant on the employment of the latter are absent, and there are few, if any, authentic instances of death resulting from their administration.

The addiction of the Oriental to the use of hashish has led to many exhaustive inquiries into the extent of the practice and the character of the drug employed. It appears that there are several preparations to which the name hashish is loosely applied, including mixtures for smoking and chewing, as well as an intoxicating beverage. In India the drink is called *bhang*, the smoking compound *ganga* or *charas*, and the chewing mixture, which is a sort of confectionary, *madjoon*. All of these preparations are built up around cannabis; but investigation has disclosed that other potent drugs also are included, especially opium, henbane, and one of the daturas, an Eastern relative of our jimson-weed. In those where the objective is the development of a sexual trend of mind, such drugs as musk, ambergris, and cantharides or Spanish fly are added. The term hashish is, therefore, more or less generic in character, and applies to all forms of intoxicating mixtures of the above character.

The fact that the use of cannabis in the East is invariably associated with other powerful drugs no doubt accounts for the remarkable dreams, deliriums, manias, and sexual excitations that have been reported

as accompanying the hashish habit. In the Occident the choice of the drug addicts has been either for the opiates or the coca preparations and alkaloids, and they prefer to take them straight. There has been no incentive for them to adulterate their potions with cannabis, and the use of preparations composed solely of this drug to satisfy a morbid craving is virtually unheard of. Hare [6] states: "In the Anglo-Saxon race the cannabis indica habit is practically unknown." And Wilbert [7] reports: "So far as I know there are no authentic drug addictions on record among the Anglo-Saxons."

That cannabis alone, or what is termed a solid extract of the drug, produces a form of intoxication has been conclusively demonstrated. The temperament and occupation of the individual apparently influences the visions manifested by the drug's action. For instance, a person of artistic leaning will visualize remarkable color schemes, spectacular designs appearing on the retina of the brain emblazoned with hues of beautiful tints and shades. It is reputed that designers of bold creations sometimes treat themselves with moderate doses of cannabis extract, and, while under the spell of the drug, evolve unique patterns with gorgeous and concordantly blended illuminations. Possibly the startling and ludicrous effects produced by the artists of the cubist school, a temporary fad of a few years ago, were in some instances suggested and perhaps directed by cannabis intoxication.

Another feature of cannabis bacchanalia is the re-

[6] "Practical Therapeutics," 1916, p. 168.

[7] Therapeutic Gazette, November 15, 1910.

action of the individual to the factor of time. Intervals of a few seconds may assume the proportion of minutes or even hours. For example, a person under the influence of cannabis reported that, on attempting to bathe, the soap slipped from his hand and appeared to float to the floor like a feather, the interval consuming, to the mind of the inebriate, the space of several minutes.

Opiates and coca preparations furnish the wherewithal for satisfying the cravings of the addicts of the Anglo-Saxon race, the former comprising by far the larger proportion of the total consumed. When mention is made of the drug habit or the "dope" evil, the reference, in ninety-nine cases out of a hundred, is to the use either of the opiates or the coca preparations. They are the drugs that are most pernicious from the standpoint of habit formation. Their consumption for morbid purposes completely overshadows that of all the other drugs combined.

The two drugs come from opposite ends of the earth. The evolution of the opium poppy occurred in what is now Asia Minor; the evolution of the coca tree in the lower ranges of the mountains on the western coast of South America. Opium, the coagulated juice of the poppy capsules, has been a factor in the life of civilized man in the East for thousands of years. Coca leaves have figured in the activities of the aboriginal inhabitants of the western world south of the equator ever since social life was established there.

The production of opium was extended from Asia Minor to Persia and then to India, following the migrations and intermingling of the races in ancient

times. At a considerably later period it was taken up by the Chinese. The commercial supplies of modern times have come from Asia Minor and India.

The capsule of the opium poppy is considerably larger than that of the familiar ornamental flower of our home gardens. At the time the petals are beginning to expand, it is full of a sticky, milky juice resembling the liquid that exudes from the common milkweed when its stem is fractured. On the opium plantation, when the plants have reached this stage in their growth, the laborers go through the field and with a sharp knife make several incisions in the wall of the capsules. Through these wounds the milky juice exudes and, spreading over the surface, soon coagulates and becomes dark brown in color. Later on this exudation is scraped off and collected, with accretions from other capsules, into a mass the size of a cannonball. These balls constitute the commercial product known as gum opium.

The crude drug is a complex of various chemical substances, including some twenty alkaloids, among which morphin predominates. It also contains a goodly proportion of gums, resins, water, and plant acids. The quantity of morphin runs considerably higher in the gum from Asia Minor than in the Indian product. The crude opium is used directly for the preparation of laudanum and paregoric, as well as a host of mixtures in which it is combined with various other remedial agents.

Morphin and codein are extracted from opium by the manufacturing chemist. To obtain them, the gum is broken up and treated with acidulated water, which

dissolves the alkaloids, leaving behind a large quantity of inert material. This acid solution of the alkaloids, on subsequent manipulation, yields a precipitate of crude morphin, from which the liquor is filtered away and treated later for the recovery of the codein. The crude morphin is grayish brown in color. When dissolved in dilute sulphuric acid and the solution treated with decolorizing agents, there is finally obtained a mass of fluffy white crystals of morphin sulphate, the product from which nearly all the commercial morphin preparations, pills, tablets, cough syrups, etc., are made.

Morphin sulphate is prepared for the market in little cubes about the size of small sugar lumps, each unit consisting of a mass of white matted crystals. It is one of the forms of morphin that finds its way into the avenues of the dope traffic. The tablets for hypodermic use are usually triturates, and are made according to the process we have described in a preceding chapter.

Codein is purified in a manner similar to morphin. Its employment by addicts is limited, when compared with the quantity of morphin consumed by those unfortunate victims of the deplorable evil. Most of it goes into the preparation of cough mixtures and remedies for headache and fever.

Heroin is now extensively used by addicts as a substitute for morphin. It is a derivative of the latter, obtained by introducing the element of acetic acid into the morphin molecule. Chemically it is diacetyl morphin. In its legitimate field it functions largely in cough mixtures, asthma cures, and

other medicines for the nasal and bronchial tracts.

Preparations of gum opium, morphin sulphate, salts of codein, and heroin constitute the bulk of what are popularly designated as the "opiates."

Smoking opium, prepared in China, formerly came into the United States in large quantities; but in 1909 Congress passed a law prohibiting its importation for other than medicinal purposes. Some idea of the extent of the traffic may be acquired when it is stated that, in 1908, 147,624 pounds were imported. It came packed in small bronze boxes each holding a little less than half a pound, the outside of the box bearing a label covered with Chinese characters.

The preparation of smoking opium is very simple. The gum is extracted with hot water in a suitable container, the liquor strained off from the débris, and evaporated to the consistency of thick molasses. It is then ready for use.

Up until a comparatively recent date, gum opium was produced in China, but with the advent of new political conditions in the Empire the opium industry was abolished. Virtually all of the gum of Chinese production went into the manufacture of smoking opium. The Indian opium likewise has been converted almost entirely into the same commodity, and for years was sent into China to augment the supplies of domestic manufacture. Conditions have altered considerably in recent years, and the Chinese government is now striving to the best of its ability to prevent the further debauching of its population through the agency of the insidious drug.

The gum opium formerly produced in China, and still obtained in India, comes from a variety of poppy known as the white poppy. It has a lower morphin content than the gum yielded by the black variety, which furnishes the drug coming out of Asia Minor. The supplies of opium imported and used commercially in the United States are comprised almost exclusively of the Asia Minor or so-called Smyrna gum. This gum, on account of its relatively high percentage of alkaloid, is preferred by the manufacturer of medicines; and, when compared to the Chinese product, the smoking opium surreptitiously prepared from it in this country shows a higher content of alkaloid.

Adams and Doran,[8] commenting on the manufacture and use of smoking opium, amplify Thorpe's [9] summary of the four varieties of opium recognized by the Chinese. These are:

1. Raw or crude opium (that is, the crude gum opium).
2. Prepared opium (or the finished product for smoking).
3. Dross or pipe cleanings (the ash remaining after smoking. This is known among Chinamen, at least in the United States, as *yen-shi*).
4. Opium dirt, or the exhausted marc after extraction of the gum opium.

They state further that when smoking opium is prepared in this country

there is added to the evaporating mass, in some cases, the water extract of the yen-shi, or pipe residue, and in other cases the yen-shi in toto. This practice is claimed by some

[8] Journal of Industrial and Engineering Chemistry, 1912, p. 429.
[9] "Dictionary of Applied Chemistry," Vol. 3, p. 72.

to add flavor to the finished product, but as the use of yen-shi or yen-shi extract has not been detected in smoking opium of known Chinese manufacture, it is fair to assume that its use in this country is purely a matter of economy in the recovery of some of the unconsumed opium in the yen-shi, or possibly the familiar process of adulteration.

The process of smoking opium in the opium dens or so-called hop joints is substantially as follows:

A small mass of the material about the size of a pea is taken upon a "dipper" or a small metal rod, known as a yen-hook. This lump is dexterously rotated in the flame of a small lamp, usually a peanut-oil lamp, until the excessive moisture is driven off and the mass is partly incinerated, or until the "pill is cooked."

It is then placed in the bowl of the opium-pipe and held just over the flame of the lamp and the smoke from the "pill" inhaled. The preparations for smoking occupy ten to fifteen minutes, the actual operation of smoking about thirty seconds.

The Chinese laborer, who takes his portion of opium regularly every day of his life, who belongs to the class of moderate users making up a good proportion of the patrons of the opium traffic, and whose ancestors for generations have been accustomed to the effect of this drug, goes to the opium den, pays his money, obtains the use of a pipe, a lamp, and a needle. He dips the needle into the box of opium, twists it around, and withdraws a mass of the treacle-like substance. He holds the sticky mass over the flame of the lamp, rotating the needle, while the heat drives the moisture from the bubbling opium. When it attains the consistency of molasses candy, he lets it cool, kneading it

in the bowl of the pipe until it assumes the shape of a cylinder. Then he plunges the point of the needle into the hole in the pipe-bowl, adjusts the little cylinder of opium into an upright position, deftly twists the needle and withdraws it, leaving the drug now with a hole through the center of the mass where the needle was, in juxtaposition to the hole in the pipe-bowl.

He is now ready to begin operations. Expelling all of the air from his lungs, he applies the flame to the pill and with several deep inhalations fills his lungs with the fumes of the burning opium. If he takes two or three smokes he usually retires to a bunk to sleep off the effect of the drug. He is frequently satisfied with a single indulgence.

Close observers believe that the Chinaman who uses opium in moderation suffers no ill effects. The drug seems to act to prevent bodily waste, thereby staving off fatigue and enabling the user to perform labor in excess of what he could do without the drug. It is on the same theory that the coca-chewer is enabled to endure the strain of several days of uninterrupted traveling on foot across the Andes. Fatigue is due to the accumulation of waste in the body. It requires food, rest, and sleep to eliminate the accumulation and repair the waste. The stimulus of the coca retards the waste of the tissue and thereby staves off fatigue.

Aside from the native South American, the use of the drug coca has never attained the proportions that opium has beyond the borders where it is produced. It is its principal alkaloid cocain, separated from the

drug and converted into the hydrochloride, that is responsible for the widespread addiction to the use of "coke."

The coca tree has been cultivated on the west coast of South America from time immemorial. Until recently the drug was produced almost exclusively in Peru and Bolivia; but plantings from this source were eventually established in Java, and now the leaves from Java coca are a factor in the supplies of the world. Smaller amounts come from plantings in Ecuador, Columbia, Brazil, Argentina, the West Indies, Ceylon, Zanzibar, and Australia.

The coca tree should not be confounded with the tree yielding the cacao bean, from which chocolate and cocoa are prepared. This tree also grows in South America. Cacao butter, used in the preparation of cosmetics and suppositories, is obtained from the cacao bean. The coconut palm is still another species, and the fat of the nut, called coco butter, is used in the soap industry, as well as for making butter substitutes. It is entirely different in its composition from cacao butter.

In order to obtain the drug coca, the leaves are stripped from the branches, spread out in thin layers, and allowed to dry spontaneously. When freshly prepared the drug contains seven or eight alkaloids, all closely related, but with cocain predominating. By the use of a proper solvent, coal-tar benzene, kerosene, or a similar liquid that does not mix with water, the active principles are removed from the leaves, together with most of the coloring matter and a considerable amount of wax. On agitating the solvent

with a dilute acid, the cocain and other alkaloids pass into the acid solution, and when the layers of liquid separate, the undesirable color and wax are left behind in the immiscible fluid. From the acid solution all of the alkaloids are separated in a crude form, and subsequently, by proper manipulation with solvents and acids, the cocain is obtained in a pure form as the salt of hydrochloric acid.

Quantities of coca are shipped all over the world for the purpose of extracting the cocain, and to be made up into medicines representing the crude drug. Large amounts of crude cocain are prepared for export in the countries where the drug originates. This crude cocain is taken by the manufacturing chemist, properly refined, and converted into the hydrochloride.

Cocain hydrochloride is a white crystalline substance which dissolves readily in water and is an ideal substance for working up into tablets for use in the hypodermic syringe. Large quantities are powdered and made into snuffs, usually by admixture with sugar of milk or acetanilid. It is by means of the hypodermic needle and by snuff that the "coke" addicts are satiated. At one time the drug market was flooded with a number of catarrh powders featuring cocain hydrochloride as their essential ingredient; but the authorities of the national government, incident to the passage of the Food and Drugs Act and the Harrison Narcotic Law, have, to a large extent, curbed their sale and driven them out of the trade.

The extent of the traffic in narcotic drugs is difficult to estimate. The importations of opium amount to more than half a million pounds annually, a consider-

able proportion of which is converted by the manufacturing chemist into the salts of morphin and codein, or the derivative heroin, while a goodly quantity is compounded by the medicine manufacturers into extract and tincture of opium, cough syrups, and other special preparations. Proprietary or patent medicines absorb but a very small amount of the total. Some of the salts are exported, and undoubtedly are smuggled back again through the so-called "underground" route, thus finding their way into the illicit trade; although the bulk of the illegitimate trade consists of material that does not originate in this country, and its magnitude is estimated as equal to that carried on through the legitimate channels.

Except for smoking opium, the smuggled opiates consist largely of the salts of the alkaloids and their derivatives. These substances have a high intrinsic value, a few pounds being worth a small fortune, and they are easily hidden. The predilection of opiate addicts in this country is for the pure salts, and not for the crude opium. Quantities sufficient for a great many treatments can be sequestered with little suspicion, and administered at opportune moments with the aid of the hypodermic syringe, this being the favorite method of administration practised by addicts of the Anglo-Saxon race.

Coca leaves to the extent of more than a million pounds are imported annually. While a considerable proportion of the drug is brought in for the purpose of extracting the cocain, which varies from one half to one per cent., depending on the quality of the leaf, a very appreciable quantity is imported for conversion

into a special dealkaloided flavoring extract for the soft-drink trade, the cocain, as it were, being the by-product. This cocain is, of course, refined, and enters commerce either for domestic consumption or for export.

The legitimate use of cocain is limited largely to the dental profession, surgery, and nose and throat work. In recent years the introduction of a number of synthetic anesthetics such as novocain, alypin, eucain, and anesthesin have materially curtailed the employment of cocain; hence it is apparent that the bulk of that made in this country must either go into the export field or be absorbed through underground channels.

To quote Boos:

> The use of morphin causes men to become nervous wrecks, who are devoid of any sense of responsibility, weak in character and purpose, untruthful, and unfit for bodily or mental effort. They continue to decline until a large number end in hopeless insanity.
>
> After six months of use the drug begins to produce the symptoms of chronic poisoning. These symptoms disappear after each hypodermic injection, and give way for a few hours to a sense of well being and happiness, then to return with ever-increasing intensity. In time the horrible sensations of the morphinist, when the effect of the drug has subsided, compel him, with a relentless and irresistible force, to take refuge from himself and his tortures in another morphin dream. He uses the most remarkable cunning and strategy to secure the drug, and he will stop at nothing in his purpose. In the end the morphin-user lives from the morphin and in it.
>
> It is not difficult to recognize the victim. His skin is

pale and flaccid. He is emaciated (the high-grade morphinist resembles an exhumed cadaver). The face is covered with eruption. The arms show evidence of many needle-thrusts, some of them developed into abscesses on account of the septic condition of injection. The eyes are dull, the pupils small, sometimes unequal. The victim is frequently affected with double or impaired vision. The pulse is small and usually slow. When morphin is withheld from them, the victims invariably show the serious phenomena of abstinence, which at times resemble a fulminating intoxication. They feel uncomfortable, mentally depressed, fearful, are subject to profuse cold perspiration. The face is red, they are extremely irritable; at times this reflex irritability takes the form of a true delirium tremens. Respiration and the action of the heart suffer, and sometimes they seem near a dangerous collapse. A hypodermic injection of morphin acts like magic, instantly dispelling all these symptoms and giving happiness to the victim.

If the abstinence is continued the symptoms gradually abate and the victim's condition steadily improves, but the desire for morphin may be felt for weeks and even months.

The cocainist is much worse than the user of morphin, because cocain produces a kind of dementia which is expressed in a persecutional or suicidal mania. The cocainist will commit violent excesses, and even murder, when he is in his delirium.

Many of the cocainists commit suicide. If they do not lay hands on themselves, they gradually subside into a state of mental and bodily stupor. Eventually they become entirely oblivious to themselves and their surroundings, forgetting even to give attention to the ordinary physiological necessities of the body. They finally die of marasmus, or wasting of the flesh.

In advanced cases of cocainism great weakness and pros-

tration are evident. The cocainist resembles the morphinist in appearance only—his pupils are dilated and his pulse is rapid and irregular. Cocainists show a tendency to hallucination. Their bodies are more apt to be covered with abscesses than those of the morphinists.

According to the representations of a special narcotic committee reporting to the commissioner of Internal Revenue in 1919:[10]

Complete and accurate statistics of the extent of drug addiction have never been compiled and are not available.

The number of individuals addicted to the use of opium, its preparations or alkaloids, and coca leaves, their preparations and alkaloids, in the United States has, at various times, been estimated to be from 200,000 to 4,000,000. These estimates must, however, be looked upon as mere guesses in most cases, because of the fact that there have been no means available for reaching an accurate estimate in the past.

It appears that a more accurate estimate of the total number of addicts may be obtained from the data secured by those investigators who have made an intensive study of drug addiction in certain restricted communities. For example, the health officer of Jacksonville, Florida, reported 887 addicts in that city in 1913. This number represents 1.31 per cent. of the population. Upon this basis, the total number of addicts in the United States in 1918, taking the estimated population as 106,000,000, would be 1,388,600.

Information in the hands of the committee indicates that drug addiction is less prevalent in rural communities than in cities or in congested centers. It would, therefore, be

[10] Treasury Department, United States Internal Revenue, Traffic in Narcotic Drugs, report of Special Committee of Investigation.

unfair to estimate the number of addicts in the entire country on the basis of the figures obtained for New York City. Furthermore, it is the opinion of the committee that an estimate based on the number of .addicts in a small city like Jacksonville, Florida, would not be representative for the entire country. Taking these facts into consideration, the committee is of the opinion that the total number of addicts in this country probably exceeds 1,000,000 at the present time.

Data assembled by the committee show that the habit of using opiates or cocain is acquired through association with addicts, through the physician, and through self-medication with these drugs or patent or proprietary preparations containing the same. The first two ways in which addiction is acquired are about of equal importance at the present time, the last being of lesser importance in the light of the replies received to the questionnaires sent out.

The addict of the under-world, in a large majority of cases, acquires the habit of using these drugs through his or her associates. This is probably due to the fact that addicts of this class make use of heroin and cocain most frequently, these drugs being employed as a snuff. It is therefore an easy matter to treat a companion to a sniff of the "dope." In addition, these drugs are made use of by "white slavers" in securing and holding their prey, and by prostitutes in entertaining their callers.

With respect to the addict of good social standing, the evidence obtained by the committee points to the physician as the agent through whom the habit is acquired in the majority of cases. Some, however, become addicted to the use of these drugs through self-medication, while a few first indulge as a social diversion.

The drugs used by addicts in order of their frequency, as shown in the replies to all forms of questionnaires sent

out by the committee, are as follows: morphin, neroin, opium (all forms), and cocain. Codein, laudanum, and paregoric are reported as being used in about equal amounts, but to a lesser extent. In recent years the use of heroin has greatly increased, and in some communities it is at present used more extensively than any of the other drugs. This is believed to be due to the ease with which it can be taken, it being usually employed as a snuff, and to the fact that the habit is acquired by association in a large majority of cases. It is at present regarded by many as the most dangerous of these drugs from the standpoint of habit formation and the creation of new addicts.

Investigation into the question of the future status of drug addiction indicates that the evil is on the decrease. Out of a total of 321 municipalities it was reported by the police officials of 287 that the proclivities were declining, while in 34 cities an increase was noted. The increases were in the larger cities, while the decreases occurred in the smaller cities.

Ever since the extent of the opium traffic began to make an impression on the philanthropic mind, concerted efforts have been directed toward controlling the distribution and use of the drug. One object has been to prevent the utter debauch of the Chinese population, another to curb the increasing addiction to the drug by the inhabitants of the western hemisphere. In 1873 some 13,500,000 pounds of Indian opium went into China. In the nineties the value of the annual opium trade with China was estimated at $40,000,000.

The Chinese government itself at last took action to prevent the enormous drain on its resources; but its efforts were fraught with difficulty, owing to the firmly

entrenched monopolies that controlled the production and distribution of opium. Political considerations embarrassed the situation.

Finally, representatives of the great powers met in convention at The Hague to discuss ways and means of treating the matter in hand from an international aspect. The Hague convention has been more or less of a permanent affair. Consequent to its deliberations, the powers signatory thereto have adopted legislation affecting the dope evil within their respective jurisdictions, and the production of opium has been nominally abolished by the Chinese.

In the United States, owing to the efforts of the late Hamilton Wright, a law, known as the Harrison Anti-Narcotic Act, was passed in 1914, controlling the importation, manufacture, and sale of opium and the opiates, and of coca leaves and their derivatives and preparations. The administration of the law has been markedly beneficial, and has caused no unreasonable hardship to the legitimate use of the drugs in medicine and surgery.

Wright's untimely death was a calamity. Having lived in the East, where he had an opportunity to observe conditions at first hand, he was fully alive to the narcotic problem. Recognition of his grasp of the situation and the advice and influence that he could give was conceded in the international counsels. There is an immense amount of regulatory enactment yet to be inaugurated, and the working out of the problems will demand the consideration of men of universal attainment, with the strength to make and carry out recommendations for the benefit of humanity at large.

Through all the congresses seeking to legislate on a problem affecting the personal habits of a people, it must be borne in mind that a medium that in its abuse is a menace may, when properly handled and used in moderation by an alien race, possess a certain ritualistic aspect, and that to meddle with it would be dangerous, so that instead of being a benevolence it might prove a malevolence. Many careful observers consider that the moderate use of opium by the Chinese laborer is of no detriment to his well being. He might get along without it, but he derives a certain amount of satisfaction from his habit, just as the average Caucasian turns to his cigar or pipe of tobacco.

One familiar with the extent of the use of narcotic drugs can easily visualize the upheaval that would occur in South America if steps should be taken to deprive the native population of the coca leaf, which has been bound up with the customs and religions of the race for countless generations. The Anglo-Saxon has never become addicted to coca-chewing as a racial habit. The "coke" habitué satisfies his craving with the hypodermic needle or a nasal snuff, using the hydrochloride of cocain as the satiating agent.

It is quite within reason that, if the Anglo-Saxon adopted coca-chewing, his reaction to the drug would be very different from that obtaining with the South American Indian. It is also probable that if the latter became addicted to the use of cocain through its introduction into the body by means of the hypodermic needle, or by the absorption attendant on the application of a concentrated form of the alkaloid to the mucous membrane, his reaction would be very different

from that of the coca ingested through the alimentary canal.

The immediate problem in China is the debauching of the population through the medium of morphin in some form or other. This form of addiction has developed since the abolition of opium production in the country and the restrictions incident to the importation from abroad. Morphin, however, is easily smuggled into the country, and, furthermore, due to certain regulations in the administration of foreign post offices maintained in Chinese territory, the drug enters unmolested in quantities that it is impossible to estimate. The effect of morphin on the Chinaman is apparently different from that produced by the action of opium.

We referred above to the prevalence of coca-chewing among the South American natives. This practice has been in vogue from the remotest antiquity. It is probable that the constant ingestion of the drug with the cocain which accompanies it produces a form of permanent anesthesia. Whether or not this would act as a deterrent to the uplift of the race is a problem for the physiologist and the psychologist; but if a type of passive anesthesia is produced by the absorption of cocain from the alimentary canal, it may be that an explanation is provided for the ability of the prehistoric Inca to submit to the heroic operations on the skull that were noted in a previous chapter.

In this connection it is in order to digress for a moment to touch upon a new method of producing anesthesia, practised with success by Baskerville and Gwathmey in New York. By means of enemas of

ether in solution with a bland oil, these experimentalists have produced insensibility and conducted a large number of surgical operations with the same ease that is possible when the anesthesia is induced by inhalation. None of the unpleasant after-effects of the ether, always attendant on an operation conducted in the customary way, occur when the new method is followed, and it is possible that a new era in the history of anesthesia is dawning.

The citation of these experiences and the effects incident thereto has been made on account of its relation to the discussion of a possible analogous action of the coca leaf on the human physiology. Pathologists recognize that the action of a drug on the bodily processes as a whole is usually very different when administered by way of the mouth or the rectum than when injected directly into the blood-stream or inhaled through the respiratory tract.

At the present time the immediate problem concerning the traffic in narcotic drugs is the control of smuggling and peddling operations. The phase of the situation with an international significance is that which has to do with the smuggling into China of morphin salts made in the United States and Great Britain. In so far as our country is involved, it is thought that certain amendments to the Harrison law will curtail a portion of the responsibility to which we have been a party; but it will not prevent the leaks occurring through theft and other illicit practices.

Salts of morphin and cocain are exported by our manufacturing chemists in accordance with the prescribed rules and regulations of the Harrison law, only

to be diverted from legitimate use in the foreign land and smuggled back here through underground channels.

The methods adopted by the operators in the illicit traffic are many and devious. Morphin salts and cocain of foreign manufacture are smuggled into this country in enormous quantities. American-made goods are exported through legitimate channels, only to return via the underground route. Border-running and connivance with confederates at the steamship terminals is a lucrative occupation, and, though accompanied by considerable risk, results in the entry of many thousand ounces of smoking opium, the opiates, and cocain.

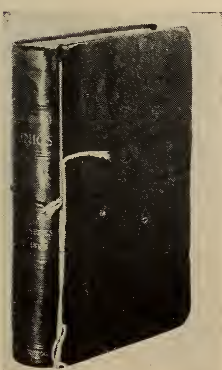
Goods are brought in under cover concealed in automobile tires, the hollow leg-bones of poultry, and barrels of vegetables and other food supplies. One large seizure of morphin sulphate shipped in from China was stuffed in the hollow legs of some Oriental bamboo chairs.

The peddlers who supply the habitués with their daily allotment of dope are as cunning as the smugglers. One resourceful individual concealed his wares, consisting of tablets of morphin sulphate, in a hollow crucifix split lengthwise and opening on a pivot. Another emulated an innocent book agent. He ambulated about town with his stock in trade under his arm, and when apprehended, the treatise was found to have the edges of the leaves and one of the covers glued together, with the body of the pages cut out, thus leaving a booklike box, innocent-looking and well adapted for his business. His outfit included several

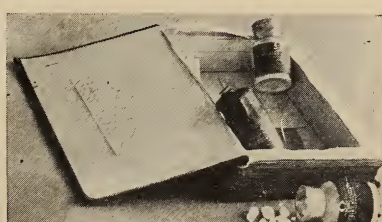
COCA BAG OF PREHISTORIC INCA FOUND WITH EXHUMED BODY

OPIUM AS IT ENTERS COMMERCE

Coca Leaves in Foregound



An Inoffensive Looking Book



The Same Book Open

TRICKS OF THE DOPE PEDDLERS

THE OPIUM LAYOUT OF THE ORIENTAL

ARTICLES AND INSTRUMENTS USED BY THE OCCIDENTAL ADDICT

bottles of morphin sulphate and powders of cocain.

Many interesting subterfuges are employed for placing dope in the hands of habitués who are in confinement and unable to make direct connection with their customary sources of supply. In one instance a prisoner, whose appetite for narcotics was acknowledged, appeared to be living a life of contentment and obtaining his palliative with a regularity that exasperated the watchful attendants. Finally he was caught in the act of chewing the pages of the letter which he received daily from his wife, and subsequent examination of the unused sheets showed that they had been soaked in a solution of morphin sulphate and dried, previously to being incorporated into the wifely epistle.

The legitimate distribution of the narcotic drugs is under fairly satisfactory control, owing to the intelligently constructed laws framed under the auspices of The Hague conferees. There is, however, no limit set to the manufacture of morphin, codein, heroin, and cocain, and it is openly acknowledged that the quantities produced far exceed the legitimate needs of medicine. Until there is some agreement among the nations as to the restrictions that can reasonably be placed upon the production and export of opium and coca, and the manufacture of their alkaloids and salts, there will be no relief from the troublesome problem of the narcotic addict which has disturbed the world for a century.

CHAPTER XI

SELF-MEDICATION—THE FAMILY MEDICINE CHEST

In writing a very good philosophy of life Chesterton[1] says:

> I think there are normal things that a normal man ought to do, as he sleeps or wakes or walks. One of them is to sing. Another is to dance. Another is to recite poetry if he likes it. Another is to be at ease and tolerably intimate with domestic animals. Another is to know quite common remedies for quite common maladies.

Wilbert[2] believes that

> as an abstract thesis it would be fair to assume that, within certain limits, mature, otherwise sane persons have the right to select and take their own medicines. . . . The inherent right to self-medication is limited primarily by the broader and more comprehensive rights of the community at large. It is generally accepted that diseases that are recognized as being infectious or contagious involve matters of public policy, and the welfare of others will frequently, if not always, require that patients ill with such a disease be properly treated by authorized persons, and, if necessary, be isolated to prevent the spread of infection.

The earliest attempts at remedying diseased conditions were by means of herbs. Primitive man undoubtedly recognized the advantages of life in the open, with a well ventilated habitation, if he had any

[1] A Miscellany of Men, 1912, Preface, X.
[2] Public Health Reports, vol. 30, No. 7, February 12, 1915.

at all, and free access to pure water. To quote Garrison:[3]

> The Indian knew, for example, the importance of keeping the skin, bowels, and kidneys open, and, to this end, the geyser, the warm spring, and the sweat-oven were his natural substitutes for a Turkish bath. Emesis or catharsis, followed by a vapor bath and a cold plunge, set off by a dose of willow-bark decoction (salicin), was the North American Indian's successful therapeutic scheme in the case of intermittent and remittent fevers; a vapor bath and cimicifuga were his mainstays against rheumatism. Like the ancient Babylonians, he had his fixed periods for ritual emesis and catharsis (*e.g.*, the green-corn feast), much as our forefathers used zodiacal calendars for blood-letting. Massage was long known and practiced by the Indians, Japanese, Malays, and East Indians; hypnotism by the Hindus ; innoculation against smallpox by the Hindus, Persians, and Chinese.

At this time there are, among the numerous schools of ideas relating to the treatment of disease, two that have been going round the circle in opposite directions and are about to come together. On the one hand are the believers in the effect of mental suggestion over the condition that we term disease. Some of the sects do not recognize the existence of disease, and even abhor the thought of using medicine for any purpose. On the other hand are a group of super-ethical medical theorists and their innocent satellites who are steeped in the belief of medicine and medical traditions, but who hold the use of drugs in disfavor, though they may, on occasion, prescribe calomel and

[3] "History of Medicine," 1913, p. 22.

strychnin, and perhaps employ ergot in an emergency at childbirth. They are known in the professional world as therapeutic nihilists. When they finally dispense with calomel, strychnin, and ergot, they will have met the mental suggestionists, and the circle will be complete in so far as the materia medica is concerned. Their pharmacopœia will be a book of blank pages.

But, regardless of the beliefs and experiences of these ultra schools, the typhoid and diphtheria microbes still persist in attacking the population and taking their annual toll; smallpox will break out unless prophylaxis by vaccination has been thorough; people will expose themselves, catch pneumonia and a host of other ailments; and the ragweed pollen will annoy periodically during its midsummer frolic. These facts were appreciated by Wilbert,[4] who in his dissertation on self-medication says:

> The followers of cults or pathys who pride themselves on their abstinence from drugs frequently overlook the fact that foods, like drugs, may have a decided influence on the normal reactions of the human body, and that many exterior forces can produce changes in the normal physiological functions of the body, resulting, either directly or indirectly, in toxemias as profound as any produced by drugs.

Fortunately, the rank and file of the medical profession is made up of level-headed individuals whose common sense enables them to select and supply the best of the discoveries of all the schools; and the rank and file of our population know when they are sick and

[4] *Op. cit.*

in need of something to restore them to health; they know when they need the family doctor, and some of them know what to do for themselves to combat the simple ailments.

Considered from one aspect, the human body is a vast chemical complex, made up of a very large number of different substances. Some of these are very simple in character, as, for example, sodium chloride, hydrochloric acid, and water. Others, like the blood compounds and flesh proteins, are complicated in their structure. Between the two extremes there are normally present a great variety of substances taking part in the make-up of the grey matter of the brain, the mineral structure of the skeleton, the nails, spinal cord, blood-serum, and digestive juices.

The system also contains a quantity of individual chemical laboratories in the shape of vital glands, creating continually certain necessities for the proper functioning of the chemical complex as a coördinated whole. Thus the liver is turning out a stream of bile that plays its part in flushing the alimentary canal; the pancreatic ducts are producing digestive juices for converting the ingested food into materials assimilable by the blood; the salivary glands are generating saliva with its accompanying diastase to provide moisture for the mouth and a digestive agent for our bread and other starchy foods. Then, there is the thyroid gland, the pituitary gland, the prostate, and many others, all fulfilling their functions in the intricate chemical system.

The proportional amounts of these thousands of chemical substances and the vigor and output of the

vital laboratories differ with each individual, and that is one reason why no two people are alike and human nature is such an interesting study.

When the adjustment of this chemical complex is properly coördinated to the individual, when there is no mechanical disruption, such as a broken bone or a dislocated joint, when the mental condition is placid, then there is perfect health. But if, for any reason, the system becomes discordant in its functioning, if there develops a paucity in some of the essential chemical individuals, or a foreign member obtains a foothold, then a condition of discomfort is set up and the individual becomes ill.

In order to bring about a restoration to health, it is desirable to restore the chemical equilibrium of the individual. Since no two people ever display the same equilibrium, it stands to reason that they will differ in the response that they manifest on being treated for an apparently identical ailment. For instance, one person suffering from chronic constipation may react satisfactorily to a saline cathartic, while another, with apparently the same ailment, will show no response to the salines, but will be cured through the agency of cascara or podophyllum.

Garrison[5] well says: "The dynamic effect of a drug upon a patient's body depends as much upon the delicate chemical adjustment of that body as upon the composition of the drug itself."

Again to quote Wilbert:[6] "The recognition of the

[5] *Op. cit., p.* 21.
[6] *Op. cit.*

inherent rights of an individual to take or to refuse to take a medicine or other remedy for the prevention or the treatment of any given disorder is, of necessity, based on the assumption that the individual is reasonably well informed regarding the nature of an infectious disease and appreciates the possibilities, uses, and limitations of available remedies and the variability of the action of medicines on the human organism."

Self-medication contemplates more than taking medicine for diseased conditions: it includes the prophylaxis that is necessary to be observed in aborting the onset of many preventable ailments. According to the Chinese system of medical attention, the physician is paid to keep his client well, not to bring him back to a state of health. Hand in hand with this, there should be a knowledge of the essentials of personal hygiene; of the means for protection against the common forms of vermin; of the cautions to be observed after undue strain or exposure; of the proper food to eat and of what constitutes a well balanced diet. Furthermore, intelligent self-medication recognizes that certain diseases should be handled only with the advice and assistance of a skilled physician.

The mental attitude of the individual plays an important part in the handling of certain abnormal conditions, notably those of the nervous system. Mental irritation or depression is a common cause of dyspepsia and biliousness. If the contributing factor is removed or the environment changed, normalcy usually results. The principle of psychotherapy now has an established

footing in medicine, but its application is limited. It cannot neutralize the toxin of diphtheria, nor combat a specific infection.

The intelligent individual of to-day recognizes the importance of keeping his scalp as free as possible from dandruff and ordinary dirt by the free use of shampoo soaps and water and the application from time to time of a good hair tonic. If accumulations develop in the nasal passages, they should be flushed at regular intervals with a bland saline wash or non-irritant antiseptic, thereby removing a source of infection and permitting the unobstructed access of air to the lungs. If the mucous membrane of the eyes becomes irritated through the accidental ingress of a foreign substance or through exposure to wind or other cause, the acute condition usually may be relieved by the application of boric acid dissolved either in water alone or in normal salt solution. Should the inflammation be due to some acid-reacting substance, as, for example, vinegar or lemon-juice, a preliminary douching with sodium bicarbonate (cooking soda) should precede the boric acid.

The teeth should receive daily attention, both sides being scrubbed by an up-and-down movement, not crosswise, employing a powder or paste indicated by the character of the oral secretions, and otherwise by the taste of the individual. Rinsing the mouth and gargling as far back as possible with an approved antiseptic wash is good practice on rising and retiring, while a gentle massage of the gums with a rubber cot in the presence of the same agent will usually serve to keep them bright and firm, thus warding off or control-

ling the ogre of pyorrhea. Chapped lips may be relieved by the application of an emollient cream, and ordinary cold-sores and fever-blisters by camphocene or similar remedy.

A few minutes' attention daily to the hands and feet will usually suffice to keep them in good condition; but if one is determined to wear ill-fitting shoes, it will be found impossible to avoid disagreeable corns and calluses. The presence of these abnormal excresences may be relieved by changing the shape of the shoe to one adapted to the foot, and then applying a reliable salve designed for the purpose. Most of these salves feature salicylic acid and cannabis sativa, and if applied consistently the corn or callus will be permanently removed. Bruises, and especially cuts, on the feet and legs should be treated with iodin solution and afterward wrapped in a smothering of aristol or some equally good antiseptic until treated. Cuts and lacerations on the hands and fingers should receive the same attention, and this as speedily as possible after the accident. Foreign matter should not be permitted to accumulate under the nails, especially those of the fingers, and hang-nails should be removed by means of small sharp scissors. If the cuticle is hard and irregular, or if an irritation develops at the base of the nail, due to splitting or pulling away of the cuticle, the application of Cutex or some similar harmless specialty will usually remedy the condition within a day or two. Soap and water should be freely applied before eating and after exposure to doubtful conditions where infection is suspected.

The importance of bodily bathing and regularity in

personal habits is apparent to everyone, and are features of the usual scheme of living, which also recognizes that there is a necessary period for rest and exercise. A properly ordered scheme also contemplates due attention to the character of the food that should be selected to provide a diet well balanced with respect to its energizing and nutritional value.

These simple suggestions in the matter of personal hygiene are obviously just as important in the observance as a knowledge of what to do when the equilibrium becomes unbalanced and sickness results. They constitute what may be termed the prophylactic phase of self-medication.

Before we take up the discussion of the other phase of the subject, it is in order to refer to the relation of certain household pests to the public health, and therefore to the individual. These sources of infection are liabilities which, unless controlled, may upset the harmony of an otherwise perfect scheme of living and the good health consequent thereto. For several years it has been the custom to conduct intensive campaigns of destruction against the house-fly and its numerous cousins, which thrive in such profusion during the warm weather. These campaigns have a certain value in directing attention to the relation of the fly to disease and as a means for distributing infection, but they fall short of permanent accomplishment, because too little stress is laid on the life history of the insect by showing that if its extermination is to take place its breeding-places must be eliminated. The folly has been the offering of prizes to individuals bringing in

the greatest number of dead flies; for by so doing the unscrupulous have developed lucrative fly farms, to the chagrin of the altruistic citizens conducting the campaigns, for whom loss of faith in human nature is only the natural consequence. The rewards should go, not to those who spend their time bringing in carcases of dead flies, but to those who can show the elimination of the greatest number of propagating-grounds.

Flies should be prevented from gaining access to any interior, especially any place where food is prepared and served. They are prolific mediums for the spread of disease. No kind of filth, no matter how morbid, possesses anything but delight to these insects, and from it they wing their way to the kitchen and dining-room, spreading their virulent accretions wherever they alight. The householder owes it to himself and his family to eliminate the danger of this source of infection, which can easily be accomplished by means of proper screening.

As an illustration of the relation of the fly to an infected food supply, we will cite the experience of an ice-cream manufacturer whose output had been the subject of adverse criticism. His process involved the customary procedures of large-scale production: first mixing the cream, pasteurizing the mix, running it through an homogenizer where the size of fat particles is reduced to an irreducible minimum; and so on to the cooling-vats, from which the various batches are sweetened and flavored before the final operation of freezing. If pasteurization is efficient, undesirable

microbes are destroyed, and unless contamination occurs at a subsequent stage of manufacture, the cream will be wholesome. Inspection of the plant in question revealed the fact that the manufacturer was running the pasteurizer with the lids open, and that floating around in the warm cream were hundreds of dead flies. Outside the unscreened windows, a neighboring stable with a flourishing manure pile explained the abundance of the insects. Their dead bodies, with the accompanying microbic spores, passed into the homogenizer with the cream, and later in the cooling-vats the conditions were right for the spores and unkilled bacteria to develop a vigorous growth. After the windows were properly screened, operations were suspended while the interior of the apparatus and pipe-lines were subjected to a treatment of superheated steam. Since then the quality of the ice-cream has been above reproach.

Although the favorite breeding-ground of the house-fly is horse manure, it is also partial to the human excrement, and when neither is available, it selects neglected garbage, decaying vegetable and animal materials, especially the organic material on the dumping-grounds. It becomes a dangerous medium for carrying the germs of intestinal diseases such as typhoid fever, cholera, dysentery, and infantile diarrhea.

While proper screening will, in a measure, prevent the access of the house-fly to the interior of a dwelling, and the consistent use of fly-paper, powders, poisons, and traps will reduce to a minimum those that may enter through carelessness, the most logical method of abating the fly nuisance is the elimination or treat-

ment of all breeding-places. To quote Howard[7]: "It would appear from what is known of the life history and habits of the common house-fly that it is perfectly feasible for cities and towns to reduce the numbers of these annoying and dangerous insects so greatly as to render them of comparatively slight account." Complete details for controlling these pests are included in the bulletin from which this paragraph is taken. It should be in the hands of every householder, and especially of those who are obliged to deal with accumulations of horse manure and who are desirous of aiding in the reduction of the fly nuisance, both for their own comfort and for the benefit of the community at large.

In the insect world, next to the house-fly, the mosquito is the most prolific factor in the spread of disease. There are many species of mosquitoes, probably a thousand or more all over the world, most of which are annoying because of their irritating stings. The anopheline mosquito is now known to be definitely related to the spread of malaria, and the aedes (formerly stegomyia) to yellow fever. It has been asserted that the downfall of the Roman Empire was due indirectly to the malarial mosquito.

An interesting and instructive account of the life histories of these insects, with suggestions for their control, is detailed by Howard in two recent publications.[8]

Malaria is caused by parasites in the blood which feed upon the red corpuscles. The disease is transmitted

[7] "The House-Fly," United States Department of Agriculture, Farmer's Bulletin 851, p. 13.

[8] Farmers' Bulletin 450, United States Department of Agriculture.

from one person to another through the medium of the anopheline mosquito. To quote Howard again[9]

When one of these anopheline mosquitoes, which carries malaria, happens to feed on a patient whose blood contains parasites, these are sucked, with the blood, into the mosquito's stomach.

If the sexual forms of the parasites are present, those of opposite sexes at once unite. The parasite now undergoes certain changes in the mosquito's stomach. It passes through the stomach wall, and finally affixes itself to its outer surface.

Here it grows very considerably, and, after a week under favorable conditions, produces a large number of spores.

These spores, thus entering the general body cavity of the mosquito, find their way into the salivary glands. These glands secrete the irritating fluid injected under the human skin when the mosquito begins to feed.

Thus, when one of these mosquitoes, which has fed upon a malarial patient containing the sexual forms of the parasites, bites, after a week, another person, it injects these spores together with its saliva under his skin and generally into his blood.

These spores now cause, or may cause, infection or reinfection in this second person.

Thus the parasites of malaria pass from men to certain mosquitoes, and back from these mosquitoes to men.

Malarial fever is then an infectious disease, which is carried from the sick to the healthy by anopheline mosquitoes, and only in this way can it be contracted. . . .

The mosquitoes which carry these parasites, however, breed in marshes or in marshy pools and streams.

Issuing from these breeding-places, they enter near-by houses and feed upon the inmates, mostly at night, biting

[9] Farmers' Bulletin 547, United States Department of Agriculture.

first one and then others, and living for weeks or months.

If an infected person happens to be present in any of these houses, the anopheline mosquitoes biting him will also become infected, and the disease is likely, ultimately, to be carried by these mosquitoes to others and to neighboring houses.

Thus a whole neighborhood soon becomes infected, and the locality is called malarious. In such localities it is easy to find the parasites of malaria in the proper mosquitoes. Sometimes 25 per cent. or more of them are found to be infected.

In malarious localities the anopheline mosquitoes bite the healthy new-born children and infect many of them.

Such children, if not thoroughly treated, may remain infected for years. They may become anemic and possess enlarged spleens, and, of course, may spread the infection to others.

In malarious localities almost every child has been found to contain the parasites of malaria or to possess an enlarged spleen.

In such a locality, therefore, the infection is constantly passed on by means of the mosquitoes from the older children or from adults to the newly born infants, so that the locality may remain malarious for very many years, in fact indefinitely.

The anopheline mosquitoes are found in both the Northern and the Southern States. They may be distinguished from most of our other mosquitoes by the fact that their wings are more or less spotted, and that in resting on the wall their bodies incline away from the wall at an angle, while with others the body is usually parallel to the wall.

Aedes calopus, the yellow-fever mosquito, is a tropical species. It is carried, however, to points remote

from its natural habitat, both by ships and railway carriages, thus explaining the outbreaks of yellow fever in Philadelphia and other Northern cities. It transmits yellow fever from a person sick with the disease to another yet uninfected in about the same way that the anopheline mosquito carries the malarial parasite. To become infected the mosquito must take blood from a yellow-fever patient in the first two or three days of the disease. After sucking the blood it cannot transmit the disease by biting one non-immune to yellow-fever for a period of eleven days. After this time the mosquito is a menace as long as it lives.

The yellow-fever mosquito is a small insect compared to the anopheline. It is strikingly marked, but must be viewed through a lens to reveal its full beauty. The legs are banded alternately with black and pure white, and the long palpi[10] of the male show the same succession of color bands. Howard says:

> The yellow-fever mosquito is essentially a town mosquito, and the larvæ are found practically exclusively in artificial receptacles in and about houses. It can be said that its larvæ are never found in swamps, in pools, or even in temporary puddles, even when these are in close proximity to houses. In the tropics the large earthen jars in which drinking-water is kept are the most frequent and unfailing habitat of the larvæ. Rain-water barrels are abundant breeding-places. Rain-water tanks, so universally behind the houses in Southern cities like New Orleans, Galveston, and Mobile, are the source of most abundant supplies of these mosquitoes. The larvæ are also found in sagging

[10] Palpi are the mouth feelers of the mosquito; fern-like appearing appendages on either side of the beak.

gutters containing rain water, in tin cans, in cess-pools, horse-troughs, in water-closet tanks, in the drain-traps of stationary wash-stands, in the urns in cemeteries, in the holy-water fonts in churches, in pools accumulating under the water-tanks, in water-pans in the chicken-yards, and in the water receptacles of grindstones.

It is obvious that the individual householder should observe every preventive measure possible to avoid infection through the agency of the fly and the mosquito. Proper screening of the dwelling is essential. When exposed to their annoyances in the open, the use of repellents, such as oil of citronella or pennyroyal, will keep them at a distance, and temporary screens or netting should always have a prominent place in the camping or traveling outfit. Very fine mesh screen is necessary to keep out the yellow-fever mosquito.

The elimination of these disease-carriers is an undertaking with which the individual cannot possibly cope single-handed. It is for the community to adopt a policy of welfare to be consistently followed, not for a few short weeks in the summer under the slogan of "Swat the fly," but throughout the entire year and thereafter until the breeding-places have been cleared away.

In the general scheme of the prophylaxis it is important to realize and provide against the potential dangers attached to the rodent population. By rodent is meant not only the common rat and house mouse, but the ground-squirrel, woodchuck, and some of our native wood and swamp rats, with which the ordinary householder is usually unfamiliar. These creatures act as

hosts for certain parasites, usually fleas and ticks, which spread the germs of bubonic and pneumonic plague, and Rocky Mountain spotted fever.

The plague is transmitted by the flea from rat to rat, and from rat to man. When the plague bacilli are found chiefly in the glands, the type of disease is known as bubonic plague; when localized in the lungs, we have pneumonic plague. The latter is a very virulent and dangerous form, for it can be transmitted from man to man by the breath.

The first outbreak of bubonic plague in the United States appears to have been in San Francisco in 1900. It continued until 1904, when it became quiescent, only to break out again in 1907. Up to that time it had confined itself to the rats of that district, but in 1907 it spread to the ground-squirrels. The disease is now established among the rodents of that section of the Western coast.

It is a peculiar disease, for it appears to have long periods of quiescence, during which, though it exists among the rodent carriers, there is little sign of it among human beings. Then it appears to gather an extraordinary virulence, suddenly spreading in epidemic form over great areas with amazing rapidity. In the past untold millions have lost their lives through this terrible scourge. Europe was devastated by it in the fourteenth century, causing the death of some 25,000,000 persons, including from two thirds to three fourths of the population of several countries. The abundance of house rats in a large part of the United States, and the still greater number of our native rodents, provide the necessary medium for an out-

break of plague that would be appalling in its destruction of human life.

Rocky Mountain spotted fever is transmitted to human beings through the medium of a species of tick known in the scientific world as *Dermacentor venustus*. These ticks infest the rodents and domestic stock of the Northwest, especially in Montana. Only a small percentage of the ticks are infected, and thus people may be bitten many times without bad results.

Rats and mice are loathsome creatures, without a single redeeming quality. To a large extent they are parasites subsisting on the unprotected food supplies of man, as well as on the refuse that he leaves carelessly exposed. What they do not eat they spoil. In the United States rats and mice each year destroy crops and other property valued at $200,000,000. The rat is a lover of filth, and from its detestable home it carries disease germs from house to house, polluting the food of human beings and spreading disease in its path.

Household supplies should be protected from rats and mice, as little progress can be made in ridding the premises of these animals as long as they have access to supplies of food. Food should be placed in inexpensive rat-proof containers covered with wire netting, if necessary. Garbage should be stored in tightly covered receptacles until collected, or it should be burned where there is no efficient system of public disposal.

The individual household should adopt every precaution possible to avoid the danger of infection from

rodents, destroying them whenever they have taken up their abode on the premises. It is not enough to keep them out of the house; they should be routed from the stable, hen-house, and other out-buildings, and if a colony is established in the neighborhood, coöperation should be obtained, if necessary, to destroy it. The significance of the relation of these creatures to the state of health of a household or a community must be apparent, and by keeping them under control the danger of exposure to several menacing diseases may be avoided. Lantz [11] believes that "if half the money now spent in feeding and fighting rats could be expended in wisely planned and well executed coöperative efforts for rat repression, it would be possible, within a few years, nearly to rid the country of its worst animal pest, to reduce losses from its depredations by at least 90 per cent., and to free the land completely from the fear of bubonic plague." [12]

In the preceding paragraphs an attempt has been made to indicate the importance of the general care of the home and the person, and the general relation of their influence on the health of the individual and his family. The treatment of the subject in this way naturally involved the connection between the spread of disease and some of our more common forms of insect and animal life. We have thus discussed briefly the general features of personal hygiene and the desirability of excluding from our households and communities those carriers of disease that are always

[11] United States Department of Agriculture, Separate from Year Book No. 725; United States Department of Agriculture, Farmers' Bulletin 896. "House Rats and Mice."

[12] England passed the Rat and Mouse Destruction Act in 1920.

potential sources of danger. We now pass on to the phase of self-medication that involves the part which the individual may reasonably play when confronted with a diseased condition actually established.

Bearing in mind the postulate cited by Wilbert at the outset of this chapter, the first and perhaps the most important feature for the individual to determine is what maladies should not be handled exclusively, and in some cases not at all, by the self-administration of drugs. Included in the list should be mentioned the infectious diseases—scarlet fever, measles, diptheria, meningitis, infantile paralysis, or anterior poliomyelitis, typhoid fever, influenza, pneumonia, erysipelas, tetanus, malaria, and tuberculosis or consumption; certain diseases of the gastro-intestinal tract, such as acute dysentry, cholera, and ulcers; albuminaria, when a symptom of chronic nephritis or Bright's disease; uremia, diabetes, and in general any chronic condition of the kidneys; disturbances of the heart; pernicious anemia, leukemia, and, in fact any impairment of the blood-stream the causes of which are obscure; epilepsy and chorea or St. Vitus's dance; the so-called social diseases—syphilis, gonorrhea, and chancroid; cancer and other morbid growths.

The necessity for isolation of infectious diseases, barring malaria, erysipelas, tetanus, and perhaps tuberculosis, is obvious. The only reasonable treatment for diphtheria is the use of antitoxin, and the same may be said of tetanus, the injections against the latter being made as soon as exposure is suspected. Typhoid requires careful handling, and the attention of a doctor should be called to the desirability of intestinal anti-

septics, such as acetozone and alphozone, which have been proved, after wide experience, to alleviate the acute symptoms occurring in the bowels and materially shorten the duration of the attack. Malaria, when established, yields to the specific action of quinin on the parasites, but due care ought to be exercised against exposing oneself to the anopheline mosquito, which, as we have already observed, is the only way the disease can be carried from one person to another.

Mumps is an infectious malady that, in the case of young children, requires little medical attention, the chief concern being isolation from others and avoidance of exposure to dampness and temperature extremes. If the swelling becomes sufficiently pronounced to cause distress to the sufferer when moving about, the glands may be supported by means of a bandage running under the chin and joined on top of the head, with soft pads of absorbent cotton directly over the swellings. From time to time gentle applications of warm olive or cotton-seed oil will prove beneficial in relaxing the tension of the stretched skin. In cases of adults and often in young boys, the heart requires careful watching, and in males where the sexual functions have been established the testicles are prone to become considerably enlarged. Both conditions need medical attention.

The universal prevalence of the social diseases is due, in a large part, to the obscurity with which they have been veiled by the unwritten custom of the population of what we are pleased to call the intelligent nations. This silence had its pernicious effect, not only in keeping from the uninitiated a knowledge that

those diseases existed prior to his or her acquiring them, but also in tending to keep the sufferer from receiving proper medical treatment through a sense of false pride and shame. Fortunately for humanity, the chrysalis of enlightment is beginning to burst forth from its cocoon of ignorance, and information that was taboo a decade ago is now freely disseminated and discussed. With gonorrhea and syphilis, as with malaria and typhoid, the best way to handle these diseases is not to acquire them; and it is within the province of each individual to do his part in this matter of prophylaxis. While gonorrhea is generally acquired during sexual intercourse, syphilis is often contracted by contact other than between the generative organs, particularly by carelessness in using a common towel, drinking cup, or toilet. When exposure is suspected, the individual should immediately seek medical advice and institute the customary abortive measures. When actually smitten, no delay should occur in submitting to a course of curative treatments. Proper instruction of the younger generation in the home and school during the age of inquiry, and before the sexual development has proceeded to completion, will go a long way toward lessening the ravages of the social diseases. In this connection every parent and instructor should obtain from the American Medical Association a series of pamphlets [13] dealing with the subject of the venereal peril, and containing instructions to the younger generation as to their later functions in life. They

[13] "The Boy's Venereal Peril"; pamphlets by Dr. Winfield I. Hall: "John's Vacation Chums," "Life Problems," "The Doctor's Daughter."

are sold virtually at cost and should be in the hands of everyone.

Turning now to the matter of treatment of some of the simpler ailments that are of common occurrence, it is apparent that it is common practice for the average householder to prescribe for himself and his family remedies for controlling colds, headaches, indigestion, constipation, and rheumatism. In many instances he is the best judge of his probable reactions to his favorite treatment. To rely solely on self-medication for handling the conditions induced by these ailments, or to remove the causes of which they may be only symptoms, is a matter that can only be condemned, especially if a chronic phase develops.

Colds may result from a variety of causes; often they are predisposed because the tonsils are infected, or because of a run-down condition of the system. Adjunctive treatment is often a necessary accompaniment of the measures taken to remedy the acute symptoms. But the family medicine-chest should contain a full complement of well tried preparations for combating a sudden onset of coryza or cold in the head, for relieving the cough, the sore throat, pain in the chest, and other conditions that feature various types of cold. This is especially important where the physician is beyond immediate call, or where the occupation of the individual subjects him to exposure of the extremes of the elements or to the strains of heavy labor.

Headache is usually induced by some disturbance of the system, and it is obvious that a rational treatment contemplates the removal of the predisposing cause.

However, there is no reason why a person should subject himself to the discomfort of an acute headache while awaiting the opportunity to have the cause determined, especially when quick relief may be readily obtained from numerous available remedies. When headache has been induced by some unusual situation, such as excessive strain, improper eating, confinement in a poorly ventilated room, sudden onset of a simple cold, or the like, it will yield to the treatment and not recur. But if one is subject to regular attacks at frequent intervals, a deeper cause is indicated and steps should be taken to remove it. Headache may come from auto-intoxication occasioned by intestinal and liver disturbances, or from improper functioning of the kidneys, anemia, derangement of heart action, abnormal conditions in the ears and nose, neuralgia, eyestrain, syphilis, or tumors.

Rheumatism is actually a vague term, though to the average person it means a subtle and indeterminate condition accompanied by a pain in the joints or muscles. In reality there are several forms of rheumatism, some of which are secondary to gonorrheal and other infections, thus requiring the assistance of skilled medical aid in handling. Acute articular rheumatism is an infectious condition of the joints, not necessarily serious in the adult, and which, if there are no secondary conditions, usually yields to the ordinary "rheumatism" remedies. In children this disease must be carefully watched on account of its tendency to affect the heart. When the trouble becomes chronic, metabolic disturbances may be suspected; in fact, no treatment will be successful unless

the digestive organs and kidneys are functioning normally. Gout is no longer considered a rheumatic condition. It appears to be directly associated with the inability to assimilate certain constituents common to flesh foods; hence final relief must be sought through a regulated diet, arranged so as to provide the necessary quantity of energy and nutrition from sources other than meats and flesh. The aches and pains accompanying rheumatic conditions will be relieved to a certain extent by local applications of warm liniments and embrocations, the affected person treating himself or aided by some member of the family, as occasion warrants. Persons with rheumatic tendencies should, if possible, avoid exposure to sudden extremes of cold and dampness, as well as the severe strains of the parts subject to attack by the malady.

Neuritis, though primarily an affection of the nervous system, often accompanies rheumatism. It may occur from straining or injuring the nerves of an arm. Cranking an automobile, or even throwing in the gear-lever, will sometimes bring about a well developed neuritis. It is induced also by alcohol or tobacco poisoning, and by the same disturbances that cause chronic arthritis, rheumatism, and gout. When the functions of the kidneys and the alimentary canal have been restored to their proper equilibrium, the system purged of any causative poisons, and the conditions producing the strain or injury eliminated, the sufferer will be well on the way to permanent relief. The medical treatment is similar to that employed in handling acute rheumatism. Local applications will relieve the intense pain when it becomes unbearable, while rest

and sleep can be obtained with the aid of the bromides or veronal. The use of hot salt bags in contact with the arm, or in fact any part of the body affected by rheumatic pains, has a wonderfully soothing effect, and when applied on retiring will often produce a relaxation followed by peaceful slumber.

Neuralgia, also associated with the nervous system, often accompanies rheumatism. It is brought about, however, by a great many other conditions, which ought to receive proper treatment before its permanent removal may be anticipated. Home remedies may be relied upon to bring relief from the acute symptoms, just as they aid in relieving neuritis and in soothing the nerve-racking tortures of rheumatism; but if permanent recovery is delayed the deeper-seated influence must be removed.

Indigestion is one of the most unpleasant joy-killers to which the ordinarily well man is subject. Unless it becomes too obnoxious, it is usually endured as an annoyance, and treated as a natural consequence of the daily routine. The sufferer means to reform his habits some day. His intentions are determined while an attack is on, but when the discomfort passes and temptation again beckons, forgetting all his good resolutions, he fills himself with the medium for another round of discomfort. Hence the shelves of the druggists are replete with brands of pills, tablets, powders, and elixirs without end for alleviating the aches and pains of the abused stomachs of the nation's people.

Carelessness in the matter of diet is not the only cause of indigestion. It often happens that the normal digestive functions are impaired, and, unless

a general building up of the system will correct the dereliction, the missing element must be regularly supplied, or the patient should eliminate from his diet the types of food that cause the trouble. Digestion begins in the mouth, where the diastatic ferment of the saliva starts the conversion of the starchy foods into sugars preparatory for their ingestion into the system. In the stomach the pepsin, generated in the walls of that organ, reduces the complex proteins into simple nitrogenous bodies, which later in the intestines are to be assimilated into the blood-stream and carried as building agents to all parts of the body. The pancreatic juice completes the digestive process in the intestines, where the fatty portions of the food and any unchanged starches are broken up into simpler and metabolizable substances. Hence, when it is indicated that there is something wrong with the digestive function, it is important to determine the missing element in order to provide the proper artificial substitutes. Indigestion may be affected by, or even mistaken for, constipation in some form, and this should not be forgotten when attempting to bring about a restoration to health.

The usual run of complex digestive remedies provide most of the elements for the correction of dyspepsia due to the lack of any of the essentials cited, and may in addition contain a group of valuable agents for toning up the glands that secrete the digestive juices and eliminatory liquids.

Lack of attention to the diet, impaired digestive functions, or overloading of the stomach bring about the conditions characterizing biliousness, a state of the

system with which we are all familiar. It may show varying symptoms in different individuals; but there is usually headache or dizziness, languor, general discomfort, unpleasant taste in the mouth, and perhaps a yellowing of the skin and whites of the eyes. Constipation develops, and, unless treatment is instituted when the early stages are manifested, the attack culminates in a sick headache, with the discomforts that characterize it.

There are thousands of preparations designed to prevent and relieve biliousness and constipation. They usually present, in some combination or other, the well known laxative drugs, liver stimulants, and bitter tonics, but out of the maze of formulas one will usually settle on a favorite combination that gives him the relief he seeks. Some people depend entirely on calomel, others on the saline cathartics, while the vast legion of mixed remedies composed of cascara, podophyllum, aloin, senna, belladonna, nux vomica, strychnin, in one combination or another, attests to the happy results attending their use.

Constipation is, as we have observed in a previous chapter, the national ailment, being a feature not only of the disorders we have just discussed, but resulting from the sedentary life of a great mass of the population whose only exercise consists in running for the street-car or suburban train, or steering an automobile. Laziness and a false idea of modesty are frequent causes. It is also due to an insufficient supply of the liquids generated for the purpose of promoting elimination, to muscular weakness, to a disrupted nerve action affecting the lower intestine, and to other derange-

ments of the system. It may be produced by an over-indulgence in certain kinds of constipating foods, or from a diet lacking in bulk, coarse ingredients, fruit, and fresh vegetables.

Where the cause is an artificial one, it should be removed or the lacking elements supplied. Regularity of habits is of prime importance, and in this enlightened age there is no excuse for neglecting attention to the natural functions when the necessity is manifest.

To quote Hare;[14]

The use of drugs for the relief of constipation is capable of division into two parts: first, the employment of remedies to unload the bowel, which has become filled; second, the use of drugs which will so influence the intestines as to cause evacuation and produce normal activity, or, in other words, drugs which will cure the tendency instead of giving temporary relief. Of the first class we find the various purgative salts, jalap, colocynth, senna, mercury, castor oil, and rhubarb; of the second class, aloes, cascara sagrada, phenolphthalein, rhamnus frangula (buckthorn), phosphate of sodium, and small doses of podophyllin. The physician should bear in mind that defecation is a normal physiological act which must be continued all through life, and it is almost as foolish to stimulate the bowel continuously to peristalsis as perpetually to employ heart stimulants or respiratory excitants.

Although habitually employed by many persons in daily doses, the purgative salts, if given in concentrated form, are exceedingly harmful in such instances, rapidly losing their power and decreasing the patient's strength by the

[14] "Practical Therapeutics," p. 710.

abstraction of liquids and salts from the blood. They often produce anemia when constantly used. These salines are to be employed simply to unload the bowels when an excess of fecal matter has accumulated, or when irritant materials are to be swept out of the alimentary canal.

The average householder usually makes provision for treating many of the acute conditions developing from a variety of causes, and for handling emergencies and accidents that require immediate attention and relief. Remedies for croup and whooping cough have a prominent place in the medicine-chest when there are children in the home. Soothing syrups and mixtures for controlling infantile colic, as well as acute distress of the adult, are indispensable. Carron oil, cooking soda, zinc stearate, and picric-acid dressings for burns; arnica tincture for bruises; iodin and aristol, with a good supply of absorbent cotton and assorted bandages, for cuts and lacerations; antidotes for the common poisons and snake-bites; ammonia and soothing lotions for neutralizing the stings of mosquitoes and other poisonous insects; and witch-hazel jelly for relieving the discomfort of sunburn—these provide the necessities for treating the every-day accidents occurring in the usual routine of family life. A selected list of reliable drugs and medicines kept in readiness in the home is often of great assistance to the family physician. Many times they will furnish just the aid that the doctor wants at a critical moment. This is especially true in rural districts, where the nearest drug-store may be miles away.

Everyone ought to be familiar with the antidotes for

common poisons, and know how to administer them. In districts where venomous reptiles are common, the hypodermic syringe and a bottle of permanganate should always be in readiness for an accident, and when outfitting for a vacation in such localities it is well to take along a supply of antivenom serum in the emergency kit.

The family medicine-chest need not be a miniature drug store, but if intelligently planned it will enable the householder to pick the essential remedy for the numerous emergencies that are continually arising, even in the best regulated homes.

No outfit is complete that does not include a kit of surgical supplies. Sets of this character are prepared expressly for household use, and contain full complements of the ordinary articles, bandages, splints, picric-acid dressings, antiseptics, surgeon's plaster, etc., for first aid in cases of burns, cuts, sprains, and broken bones.

In the appendix where we present a list of suggestions for the family medicine-chest, it is recognized that many well known remedies have been omitted. No apologies are required, however, for it should be understood that, where names have been mentioned, they stand as types indicated in the particular class of ailment that they have been found to relieve. Special preparations featuring several drugs in admixtures, and sold under trade-names, are usually of higher quality and more efficacious than extemporaneous prescriptions made up from the same formulas. The firms making them possess all the facilities for large-scale production, and their preparations represent the

results of many years of careful thought and experimentation.

It is sometimes said, by way of disparagement, that the cost of the ingredients of these remedies represents but a small fraction of the price charged for them. The cost of the ingredients, however, is but one factor in reckoning the expenses of preparing any medicine. There are many expensive operations required to compound the ingredients and present them in permanent and assimilable form; expensive solvents are often required; and the preparation may require careful aging and testing by expert chemists before the manufacturer is willing to let it go on the market. It can be asserted with assurance that the cost of putting up a few ounces of a preparation representing the same formula, granted that the same care and supervision were exerted, would be far greater than the expense entailed by the large-scale production.

The household armamentarium appended [15] contains several items that appear to duplicate the treatment for certain conditions. Thus we find two or three kinds of saline laxatives and an equal number of vegetable remedies for constipation and liver torpidity. The reason for this is that individuals respond differently to the action of drugs, often times no two members of the same household reacting in the same way. Furthermore, the family physician may consider it advisable to call for one type instead of another, and if representatives of both are on hand, his needs are taken care of.

In homes where the family is large and on farms

[15] See page 345.

maintaining a large force of workers, the family medicine-chest is drawn upon almost every day for some panacea or other. It is an indispensable essential in the economy of the modern household.

CHAPTER XII

PAINT, POWDER, AND ROUGE: THE HEIGHT OF THE COMPLEXION

Evolution in the animal world as it has come down through the centuries to the present day, has resulted in many interesting contrasts in the various orders of natural life. Especially is this true in the appearance of the sexes. In the insect world we often find little evidence of distinction between the genders of a particular species, but again the distinguishing characteristics are extreme, as instanced in the case of the glow-worm. The male of this species is a flying beetle of no special beauty, while the female, though devoid of wings and classed as a crawling worm, develops at the mating season a wonderful display of luminosity, which, as darkness falls, shines forth with a soft green phosphorescent hue, the grayish-looking grub being transformed into one of the most beautiful of natural creations.

Among the mammals the tendency is for the male to develop characteristics of striking appearance, while the female is plainer and often of smaller stature. The fully developed lion is a majestic creature with his shaggy mane and lordly appearance, while the female shows at most but a rudimentary hirsute adornment on her neck and shoulders. The bull moose at full prime

is one of the most striking creatures of the wild, with widespread palmated antlers and pendant bell drooping from his neck, while the cow is destitute of horns and resembles at best an overgrown jackass with a tendency to a prehensile muzzle.

Among the feathered tribe there is great differentiation between the sexes. The males of the tropical humming-birds show vivid colors and remarkable adornments, while the females are usually plainer both in hue and raiment. Among the familiar species of our northern environment, the scarlet tanager is, in the male, a beautiful creature, with his ruddy plumage and black wings and tail, while the mother bird is of a somber greenish color with no suggestion of red. The male indigo-bird is as blue as the name indicates; but his mate is brown, and when seen by herself would never be associated with her cerulean mate.

Coming to the genus *Homo,* we find that, ever since the human form began scampering over the surface of the world, 600,000 or more years ago, down through the ages of the Heidelburg and Piltdown types, through the Cromagnon creatures something like ourselves in appearance, to the beginning of the Neolithic age of ten or twelve thousand years ago, and through all the ebbs and flows of the Neolithic, down to the present age of civilization, the differentiation between the sexes has gone on, until to-day we have in womankind the acme of all natural creations.

It is not the purpose of this exposition to enter into a discussion as to the superiority of sexes. Whether or not the male of the species is superior to the female is a question for the sociologist and biologist to de-

bate in their respective fields. But from an ornamental standpoint, considered especially in the aspect of external appearance, men will generally agree that at the apex of the development of the animal kingdom woman reigns supreme.

The natural beauty of womankind varies among different races and peoples. As a general proposition, the scope of physical attraction is within a race, and is generally confined to those of the same nationality. Extraracial appeal is usually momentary, though the appeal between alien individuals of the same race may be strong and often permanent.

The enhancement of natural beauty has been practiced ever since civilized man left any record of his activities. The artificial adornments and grotesque head-dresses of the ancient Medes and Persians have been permanently pictured in the artistic records that have come down through the centuries. However, the degree of embellishment depends upon the point of view from which they are judged. That which may be the customary practice of one nationality may seem utterly absurd or distasteful to another. For example, it is the custom of certain tribes to file and blacken their teeth, while among civilized people everything possible is done to keep them white.

Not many years ago heavy earrings and combs of marvelous shapes were essential parts of the head-dress of American women of refinement. Nearly every young girl underwent the ordeal of having the lobes of her ears pierced in preparation for the pendent drops that would adorn her features by the time she had reached maturity. The use of appendages of this

character gradually went out of fashion, and though to-day there is a sporadic return to them, the girl whose ears are pierced is as conspicuous as would have been one who assumed an artificial complexion a couple of decades ago.

Most conspicuously has the development of modern fashion proceeded in the direction of comfort to the individual. No longer do women torture themselves with vise-like corsets, or swathe their arms and necks in sleeves and collars that grip them like applications of surgeon's plaster. The raiment of the present day is designed to permit freedom of movement. This is the prime requisite of modern dress. The trailing skirts that twenty years ago accumulated the burnt matches, cigar stumps, and other débris of the pavement and cross-walk, and lightened the work of the street-sweeper, have given way to the shorter garments that permit the legs to exercise in a free and untrammeled manner.

The former dependence on pads, bustles, and other appliances for rounding out the form has given way to normal natural development through physical exercise, massage, bathing, and athletics.

The development of modern fashion has been not only in the direction of comfort, but with due regard to the activity or occupation in which the wearer is engaged, to the end of producing a charming effect as well as serving a practical purpose. The early automobile costumes were freakish in design, and the various accessories with which the person was encumbered produced a result that was ludicrous in the extreme.

Common sense, and a realization that the ideas formerly in vogue respecting the character of the external covering were prudish, have been in a large measure responsible for the sensible character of the dress of the American woman of to-day. Hand in hand with the emancipation of the female mentality from its adherence to the principles that had narcotized it for generations, there has developed an appreciation of the importance of an attractive physical presence and an acknowledged use of artificial means, if necessary, for attaining this end.

Physical attraction contemplates not only that the facial features should be well balanced and unmarred, but that the anatomy as a whole should be in keeping with the individual type, be she short or tall, rotund or spare, blond or brunette. The proper development and maintenance of those physical characteristics to which the charm of woman's appearance is due depends in large measure on *careful attention to personal hygiene and the free and unaided functioning of the bodily processes.* This has been emphasized in the chapter on self-medication. With the advantages of present-day education, and the ability to make use of the unlimited talent specializing in the care of externals, there is no excuse for unhealthy and dandruff-specked hair, oily or pimple-spotted complexions, rough hands and fingers with irregular nails, sunken chests and attenuated busts, hips and legs out of keeping with the stature, or shapeless feet with nerve-racking calluses.

Twenty years ago the use of cosmetics that left their visible mark on the features, or that were intended to

produce a heightened complexion where nature had been tardy, or physical neglect was manifesting itself, were indulged in only surreptitiously. The enlightened portion of our population at that period considered, no doubt with reason, that facial embellishments and artificial aids for improving the appearance of the anatomy in general were employed principally—off the stage—among what we are pleased to term the demi-monde.

Happily, however, for the approving vision of man, it is no longer shocking for a girl to apply to her forehead, cheeks, and nose an innocent face powder for the purpose of absorbing an excess of perspiration that would otherwise produce a mirror-like effect to her countenance. She may also without criticism blend into the natural hue of her complexion shades of color that create a blush that is in keeping with her type, and the artificiality of which challenges the scrutiny of an expert to discern.

The present-day tolerance concerning the use of preparations for maintaining and improving the appearance of the features is illustrated in the expression of a representative American woman of wealth and refinement, who not long ago remarked that, in her belief, it was the duty of every woman to look as well as she possibly could. Her own daily applications, she said, included not less than a dozen different formulas. Her acknowledgment is typical of the present practice, which amounts to an almost universal indulgence in the use of cosmetics and toilet articles of varying character and purpose.

It is our purpose to enlighten the curiosity of the

public concerning the character of these various preparations. Their number is legion. They are of all sorts and descriptions and they are accessible to the poor as well as to the affluent.

Included in the list of so-called "beauty" specialties are not only those that are designed for the numerous attentions accorded the facial features, but those for treating the hair, hands, nails, bust, hips, legs, and feet. Products for checking excessive perspiration, allaying sunburn, and removing freckles likewise are now included in a general list of toilet articles, and the fact that bathing has become a daily indulgence instead of a weekly observance has brought about a demand for an immense variety of powders, salts, soaps, and other accessories designed especially for balneal purposes. Perfumes and toilet waters fall naturally into the classification of boudoir indispensables.

Taken altogether, in many modern homes the boudoir cabinet occupies a place of as much importance in its own particular field as does the family medicine-chest.

In the minds of many inquiring people it would appear that the belief is prevalent that the various applications for the face, lips, hands, and nails contain harmful substances, and that their continued use is more or less deleterious. As a matter of fact, most of the toilet accessories—powders, rouges, creams, etc.—are simple in composition and seldom contain anything harmful to the skin or complexion. There is nothing mysterious about any of them, neither is there anything complicated about their formulas, except the perfumes, which are usually blends of several oils

possessing a pleasing fragrance—this being often a determining factor in the popularity of a particular preparation. If a batch of finely bolted talcum powder should be divided into two parts, and one part treated with a delicate and refreshing perfume, and both packed in tins of equal attractiveness, the portion that was not perfumed would languish on the shelves long after the other had been sold. Except for the slight mental effect, the perfume plays no part in the action of the powder; yet, unless there is some other strong appeal in the unperfumed article, the popularity rests with the one that stimulates the sensibility.

The harm that may have occurred when facial cosmetics first came into general popularity was due, no doubt, in large part to the failure of the user to remove the application before retiring for the night, or before another treatment was given. In those days the color effects were obtained more extensively by means of pastes and creams—in other words, by paint—than they are to-day, when the expert dusting on of a bit of dye-impregnated powder develops the bloom of youth for the sunlit street, or the rosy hue that heightens the complexion at night, neutralizing the ghastly lividness produced in the natural skin pigment by the glare of artificial illumination.

Not long ago a young society woman, whose comeliness made her the center of an admiring throng at one of our summer watering-places, had the misfortune to be caught in the under-tow, got beyond her depth, and was well on the way to being drowned before she was rescued and stretched on the beach for the administra-

tion of first-aid assistance. Her body showed the usual color of a partially suffocated individual, but not so her countenance, which through it all retained its customary blush and bespoke the deftness with which her attractiveness had been accomplished.

In these days, when soap and water function so extensively in the daily routine, there is little opportunity for the numerous embellishments of the toilet to remain permanently in the pores of the skin. It was on account of the discomfort and disfigurement incident to the clogging of the surface glands through incomplete removal of the applications that the former disrepute of cosmetics was generally due.

Ruined complexions have been unjustly attributed to the application of cosmetics sometimes when the trouble has been exterior manifestations of some derangement of the internal physical functionings. In such cases, when the activities are restored to normalcy the eruptions on the face disappear.

Where there is a tendency to irritation, as in hypersensitive skins, the reaction to cosmetics may be unfavorable. Certain depilatories (preparations for removing hair) contain barium sulphide, a soluble salt of the metal barium, and the irritant effect on the tissue counter-indicates their use in many cases. Most of the perspiration preventives contain aluminum chloride or some metallic astringent of similar nature, and their application on the flesh of the arm-pits is inadvisable where the sensitiveness is extreme. Hair washes were at one time heavily charged with salts of lead, sugar of lead being the favorite ingredient.

They induced an unhealthy irritation of the scalp, and were dangerous because their copious application tended to induce lead intoxication or poisoning.

Many of the hair dyes offered to the public consisted of a double treatment, one of the ingredients being an organic coal-tar derivative known as paraphenylene diamine. Other substances closely related to this were substituted, but all of this type were dangerous, because the optic nerve is particularly sensitive to their toxicity. The exploiters of these preparations apparently appreciated their harmful tendencies, for their circulars contained skilfully worded paragraphs that provided for a refund if unpleasant conditions developed.

Freckle creams usually contain ammoniated mercury or white precipitate, a white powder obtained by precipitating bichloride with an excess of ammonia. The use of preparations containing this substance is condemned in some quarters, owing to the reputed toxicity of mercurials in general. Whether or not creams designed to remove freckles have much virtue in permanently changing the speckled abnormality of pigmentation is open to question; but it is doubtful whether much harm would result from their use, since the mercury salt above noted is relatively insoluble, and, unless it got into the circulation or was ingested internally through mistake, it would not be likely to produce symptoms of mercurial poisoning.

The toilet articles and cosmetics on the market vary in the refinement of their make-up and the character of their ingredients. They are designed for all sorts and conditions of patronage. But, as we have already ob-

served, the formulas usually consist of simple ingredients, and, while there may be a thousand brands of a particular type of cream or powder or hair tonic, the composition shows little dissimilarity. The cost rises slightly with the degree of refinement and the better quality of the ingredients. The price, however, depends more often upon the form of the package and the character of the trade affected than upon the cost of manufacture. For example, the manufacture of toilet soaps is standardized to such a degree that, aside from the value of the whiff of perfume, a cake selling for a quarter costs no more to make than one that retails for a dollar. But the trade that would turn up its nose at the less expensive package cheerfully pays its dollar for the same article when more elaborately caparisoned.

Among the preparations for the general toilet, bath salts first claim our attention. Some of these are put out in the form of powders, delicately perfumed and occasionally faintly colored to heighten the esthetic effect. Again, they may appear as a mass of fine crystals. The powders usually consist of sodium bicarbonate or ordinary cooking soda, the crystalline preparations of the normal carbonate of soda, to which may be added a proportion of sodium chloride, which is common salt in crystalline form.

There are bath salts that feature a combination of powder and tablet, the former consisting of the customary bicarbonate, and the latter of fused sodium bisulphate, an acid-reacting substance. The application consists in dissolving the powder in the bath and then placing the tablets at intervals on the bottom of

the tub. The bather is supposed to recline immersed in the saline liquid to get the "effect," which consists in the gradual evolution of carbonic-acid gas, through the reaction of the acid sulphate of sodium on the alkaline bicarbonate.

All toilet soaps are made in about the same manner. A mixture of fatty acids is neutralized with a solution of caustic soda in water, and the crude soap resulting from the reaction is separated from the liquid. The fatty acids belong to the great family of organic compounds. They are usually obtained from cocoanut oil, a semi-solid fat, or from hardened cotton-seed, olive, or some other bland oil. The process of hardening is an invention of comparatively recent date, and consists in setting free the element of hydrogen in contact with the oil, with the result that the hydrogen enters the oil molecule, saturates it, as we say in chemical lore, and changes it from a flowing liquid to an immobile grease. It is on this same principle that Crisco is made.

Fats are chemical compounds of fatty acids with glycerin. When subjected to the action of hot caustic alkalis, they are broken up, the glycerin being set free and the alkali metal uniting with the fatty acids to form soap. Soaps are, therefore, really salts of fatty acids. Those made with caustic soda are solid and are known as hard soaps; those with caustic potash are liquid and are called soft soaps.

In some plants the fatty acids are separated from the fats before being combined with the alkali. In others the fats themselves are treated directly. Glycerin is a by-product of the soap industry, enormous quantities being recovered annually.

For making the high-grade toilet soaps, the crude product from the reaction is removed to a dryer, where most of the water is evaporated. The product can then be ground up or powdered if desired. It is usually run through an apparatus to render it uniform in character, after which it is mixed with the proper quantity of perfume and then stamped into cakes of various forms. During the milling process there may be added zinc oxide, borax, carbolic acid, creosote, tar, prussian blue, and various other antiseptic agents that feature the numerous facial and medicated soaps on the market. Hand sapolios contain a high percentage of fine sand.

Most of the peroxide soaps are "peroxide" only in name. The peroxides are very unstable substances. If they are added at all, they usually undergo a change to a more stable compound during the process of manufacture or while the soap is aging. Some soaps to which peroxide of zinc has been added have been found to yield a peroxide reaction; but as a rule the peroxide feature is lacking.

Our inquiry will now proceed to an examination of the various special preparations used on the different parts of the body, and we shall begin with those concerned with the health and beauty of the scalp and hair.

No argument is necessary for the general acceptance of the observation that woman's crowning adornment is her hair. When in perfect health, with its luxurious growth and accompanying sheen and flexibility, it plays a large part in setting off the comeliness of the facial features to produce the general attractiveness of the individual. The emphasis of this remark is appar-

ent to anyone who has observed the ridiculous fad of recent date, wherein the sacrifice of the hair below the ears has transformed girls of peculiar grace and gentility into grotesque caricatures.

Profusion of flexible and lustrous hair is a natural accompaniment of general good health, but the accumulation of fatty material naturally secreted by the fibers, and the dust and dirt from outside sources which gradually collect, have to be removed at periodical intervals; and dandruff flourishes on the scalps of the healthiest. Falling hair is a condition causing great concern with many people, often with reason; but the gradual coming out of the fibers is continual, and at some seasons of the year the loss assumes the appearance of a moult. It is usually on these occasions that the perennial apprehension takes place.

The shampoo soaps and the special medicated soaps for removing the dirt and accumulations from the hair and scalp differ in no respect from soaps in general. They may contain, in some instances, a little soap-bark for the purpose of developing a profuse lather, but otherwise they consist of the same ingredients and are prepared in the same way as the soaps we have already described. Soap-bark comes from the quillaia tree, indigenous to Chile and Peru. It contains a substance known as saponin, which is of complex character. Saponin, when mixed with water, has the property of producing, on agitation, a wonderful foam. It is to this effect that its name is due, and the fact that the crude material that yields it is called soap-bark.

Most of the shampoo liquids and powders are mix-

tures of soap and carbonate of either sodium or potassium. Sometimes borax will be found, and occasionally tar or some antiseptic; but as a rule they are of very simple composition. The literature accompanying these made-up shampoos is often objectionable in that the statements warn one against the use of soap, borax, or the mild alkalis, when the products themselves consist largely of these identical articles.

Hair tonics and dandruff-removers are more varied in their composition than are the other classes of hair preparations. They usually consist of a combination in dilute alcoholic solution of some of the following ingredients: quinin salts or extract of cinchona, which contains quinin, pilocarpin salts or extract of the drug pilocarpus (jaborandi), extract of sage, salicylic acid, resorcin, carbolic acid, chloral hydrate, capsicum, cantharides, glycerin, arsenic, lead, and sulphur. Massage of the scalp is an essential adjunct to the use of all these tonics and removers, but the ingredients themselves undoubtedly play their part in the effects produced. Where lead occurs, the only value of this element is to cause a darkening of the hair, through the formation in the fibers of the black sulphide of lead. It is not a tonic to either the hair or the scalp, but actually a form of dye.

Dyes for the hair are of several types. There are the henna dyes for producing various shades from a rich coppery luster to a brilliant sable. There are the metal dyes, of which the lead mixture with sulphur is an example. And there are the combination treatments featuring the coal-tar derivatives and some other ingredient for fixing the color. The use of hennas is

attended with the least danger to those of singular temperament, who may be sensitive to lead or the phenylene derivatives. History accords to Cleopatra the original popularity of the use of henna, and it is in Egypt that the supplies of this article still originate. It is the leaf of a species of lawsonia, and contains a yellow substance having powerful dying properties. Hennas for producing light effects depend upon nothing more than the natural dye occurring in the leaf. Those for developing the darker shades contain salts of copper.

The numerous powders for developing a fluffy appearance of the hair are composed, for the most part, of powdered orris root, starch, and talc. Their action is in the direction of absorbing the fat and moisture of the hair, the talc taking the place of the natural lubricant, without its adherent property. The hair, relieved of the influences that kept it matted and smooth, exhibits its elasticity by fluffing up and assuming an appearance of bulk.

Having disposed of the principle accouterments for preserving and beautifying the hair, we will next take up the preparations for the face and other anatomical features.

Powders first claim our attention; and in connection with those especially designed for the face reference will be made also to those for the body as a whole. The base of nearly all powders is talc, a mineral that occurs in large deposits in various parts of the world. Great care is taken in the preparation of powdered talc. The best grades are pure white in color, free from particles of grit, and reduced to an impalpable

form by milling and bolting. Separation of the finer particles is also effected by floating both in water and air, the larger grains quickly falling away from the finer, imponderable particles.

Body powders may consist of talc alone, or in a combination with boric acid, zinc oxide, starch, calcium carbonate (powdered chalk), and powdered orris root. As a rule the zinc oxide and chalk are lacking in the body powders; but one or the other, and often both, occur in the face powders. Complexion and face powders are of the same general character. They all contain talc, but the combinations run more to zinc oxide and chalk than to starch and boric acid.

The facial powders may contain the dyes that develop the delicate artificial hues now so universally used. These dyes are usually of coal-tar derivation, and it requires such a minute quantity to produce the desired effect that they cannot be considered deleterious to the user. They are quickly removed by the ordinary operation of the bath, and, unlike the old forms of paste paints, have little tendency to clog the pores and prevent the natural functioning of the surface glands.

Zinc stearate has come into use within the past decade, and provides a very satisfactory lubricant and soothing powder. It is more adherent than talc or zinc oxide, and, when employed for lightening the complexion, can be depended upon for a longer period. These powders are of great benefit in relieving the discomfort of sunburn, though in the early stages of the exposure a copious application of dry sodium bicarbonate will be quite as effectual in reducing the

irritation and will lessen the tendency to blister formation. The subsequent employment of an emollient lotion or jelly compound of glycerin, Irish moss mucilage, and boric acid, rubbed well into the affected areas, later to be followed by a dusting of zinc stearate and talc, will bring about a rapid restoration to normal conditions.

Facial and body creams are of four general types. The true cold creams are made on a base of some greasy material such as vaseline or petrolatum, lanolin, or lard. The greaseless or disappearing creams are combinations featuring soap and glycerin as the basic constituents. Then, there are moist casein creams and liquid creams. Some of the liquid creams belong to the second class above mentioned, but there is a type of fluid cream made up on a mucilage foundation, the emollient character being produced by decoction of quince-seed or Irish moss.

The basic constituents of the grease creams are, as we noted above, vaseline, lanolin, or lard. In the better brands none but the purest greases are used; otherwise the products develop a rancid odor, and when the perfume has evaporated they are not pleasant to use. In some creams both vaseline and lanolin are used, this type often being designated as a skin food, and recommended for nourishing the tissues of undersized busts, hips and legs. In so far as these so-called "skin foods" soften the tissues and on account of the accompanying massage, stimulate the circulation and natural secretions of the glands in the neighborhood of the operation, they may indirectly aid in bringing about an increase of cellular activity and a tendency

to increased development. But as direct foods for the skin and flesh they are ineffectual. There are no foods specifically assimilable for any special part of the body. The tissues are built up through the digestion of foods in the stomach and intestines and the transportation of the metabolized nourishment through the blood-stream to the body cells.

Combined with the basic greases are usually varying percentages of water, gums such as tragacanth and acacia, spermaceti, beeswax, and paraffin. The perfumes often characterize the product. Uniformity is obtained by thorough mixing in a machine with revolving knives, and smoothness is brought about by running the mass through a form of paint-mill.

In the greaseless creams the soap and glycerin are beaten up with water until the proper consistency is obtained, and then the perfume and any special ingredient, such as boric acid, is added. Zinc oxide often functions in the greaseless creams, and will be found occasionally in the true cold creams.

Peroxide creams were popular at one time, but they soon passed out. The unstable peroxides quickly became altered to more stable substances, and any virtue that might have been anticipated from the peroxide was lost.

A great deal of agitation has been aroused on account of the sensational claims that certain types of cream tend to stimulate the growth of hair on the face. The prevailing custom is to claim, in the literature accompanying a cream, that it will not grow hair on the face, and to warn against the use of other preparations. But no one kind of cream or other product is

more predisposed to stimulate the growth of hair than another, and, while the massaging of the flesh may produce a growth of down on the face, it is due to stimulation of the circulation rather than to the effect of the cream.

Preparations for bleaching the complexion depend either on the temporary deposition of some white powder in the pores, or the supposed action of borax, a sulphite or hyposulphite on the pigment. These products are usually offered in the form of liquids. Their effect is not that of a true bleach, and they do not alter the pigmentation. Sallowness or the pale, sickly-yellow color incident to a sedentary life undiverted by exercise or proper recreation, and which also comes from an improper diet and deranged conditions in the stomach and bowels, may be remedied first and only by taking proper steps to correct the contributing causes. Attempts to bleach the complexion amount to nothing, or at best produce a sickly pallidity. Neither will these agents remove a healthy tan, which should be admired both by the possessor and the observer.

In connection with the use of complexion bleaches, it is in order to relate an incident that occurred in Washington at a time when the Bureau of Chemistry was preparing to destroy an accumulation of obsolete samples that had figured in some of the early cases under the Pure Food Law. In the collection was a bottle of a widely advertized Complexion Bleach, a solution of borax in orange-flower water, which had been included in the seizure of several other misbranded preparations. One of the colored messen-

gers appropriated the package, and when discovered and accosted as to his motive, he replied that he thought it might make him white!

Among the preparations designed for special purposes, mention should be made of the depilatories. Some of these occur in the form of powders consisting of barium sulphide and starch, often with the addition of zinc oxide. Liquid hair-removers may contain sodium sulphide, the solutions being highly perfumed to disguise the odor of decayed eggs that characterizes soluble sulphides. These preparations will remove the hair superficially, but it will grow again unless the roots are destroyed, and the depilatories do not function beneath the surface. The complete removal of individual hairs or tufts of hirsute growth is affected by a very drastic method, whereby a waxy plaster consisting of resin and some bland oil, such as castor oil, highly perfumed, is softened and spread over the surface of the skin covered with hair. When the mixture has solidified, a deft pull tears it from the face, bringing with it the hair, roots and all.

Lip-sticks and eyebrow pencils are mixtures of fat and waxes stiff enough to be molded and retain their shape. The coloring agent is usually a coal-tar dye, soluble in the oily medium. The consistency of the preparation is such that, on being drawn over the surface to be colored, a thin film of grease is left, so that by subsequent adjustment and blending the desired effect is produced.

Though not strictly external, the teeth have a vital significance in the harmony of the facial exhibition. The multitude of brands of pastes and powders is be-

wildering, but they are more or less similar in their make-up. The semi-fluid nature of the pastes is due to glycerin, and the body is built up with calcium carbonate (chalk), soap, sometimes calcium phosphate, and occasionally pumice. Cane-sugar, and sometimes milk-sugar, with now and then a trace of saccharin, often occur, and they are all highly flavored. Some of them are colored with harmless dyes. Most of the pastes feature the mild aromatic antiseptics—menthol, thymol, methyl salicylate (oil of wintergreen), oil of cinnamon, and sassafras. One of the widely advertized pastes contains potassium chlorate. Pepsin and preparations of ipecac also function in certain special formulas.

The general run of tooth powders depend upon chalk and powdered soap for their cleansing properties. Combined with the bulk ingredients are mild and agreeable antiseptic agents of the same nature that occur in the pastes. Special brands may feature powdered myrrh, small amounts of cresol, and boric acid.

It is in the powders that one may find unaltered peroxides, and these are the only cosmetics of peroxide nature that are true to name. Perborates have been found as substitutes for peroxides, but they have the property of liberating active oxygen in contact with moisture, and hence their significance, in so far as this property is concerned, would be the same as the peroxides. In addition, the perborates exhibit the antiseptic value of the boric acid and borax.

The liquid dentifrices, of which there are a few in popular use, consist of soap and glycerin dissolved in diluted alcohol, with varying proportions of the same

antiseptic agents found in the pastes and powders. Tincture of myrrh is often included, and the color may be due to cudbear, cochineal, rosolic acid, methyl orange, or salts of berberin.

In the course of an extensive investigation of a series of preparations for preserving and beautifying the external features, there was encountered a mixture recommended for increasing the brightness and sparkle of the eyes and intensifying their natural color. It was to be taken internally. On investigation, it was found to consist of pepsin dissolved in glycerin, colored with cochineal and flavored with oil of rose. If the user happened to be a confirmed dyspeptic, with dull eyes due to indigestion, the efficacy of such a mixture might be apparent, but otherwise its use would be futile.

Among the preparations having special application to the upper extremities, those for the arm-pits and finger-nails are perhaps the most interesting. The various creams and lotions for the hands and arms differ in no essential from those designed for the face, and the depilatories we have already discussed.

The liquids that are applied to the arm-pits to prevent excessive perspiration are solutions of aluminum chloride or zinc chloride in water or diluted alcohol. Perfumes and colors of various sorts are included for the esthetic effect, and in one case a small quantity of bromide was discovered, possibly added with the idea of soothing any irritation that might have been induced by the astringent. The essential ingredients of these lotions possess the property of contracting the pores of the skin whereon they are applied. The astringency

may act beneath the surface as well, because the salts are soluble. Thus, by closing temporarily the natural openings, the secretions of the body are retained within. When the effect wears off, as it will in time through the gradual absorption of the chemicals, or if the surface deposit is removed in the bath, the normal functions are restored.

The specialties of the manicurist include enamels and polishes for burnishing the surface of the nails, whitening compounds for the under portions of the tips, and cuticle compounds. The enamels are nothing more than varnishes, that leave a transparent waterproof film on the surface of the nail. The resinous gums used are dissolved in alcohol or some other volatile liquid, and a small amount of pink dye is included to enhance the natural color of the finger-tip.

There are several types of polishes. Those in paste form consist of tin oxide or a siliceous earth, finely bolted pumice or clay, suspended in a stiff ointment of petrolatum and wax, usually colored with a dye soluble in the grease. The powder polishes are made with tin oxide or siliceous earth, with a small percentage of grease. Nail-stones are solid cakes of the same kind of polishing material held in form by means of plaster-of-paris. They are molded and baked like bricks.

The cuticle-softeners show marked contrast in their make-up. Most of them contain some organic acid, such as oxalic or citric in aqueous solution. The better class, however, are of mildly alkaline character and

contain glycerin. In connection with the use of these preparations it is of interest to relate an experience that illustrates the danger of jumping at conclusions regarding the cause of untoward physical manifestations which sometimes occur simultaneously with the application of cosmetics and remedies in general.

Complaints had been registered against a well known brand of cuticle-softener, on the ground that it was causing serious inconvenience to persons who were using it in the customary performance of their daily ablutions. Reports of infection, with accompanying irritation and other disagreeable symptoms, featured the complaints. The proprietor was a humanitarian as well as a shrewd business man, and decided that if his product was harmful he would take it off the market. The only way to determine whether the claims were warranted or not was to institute a series of investigations under scientific control, which he accordingly authorized. Physiological tests, made first on animals and later on human subjects, resulted in the discovery that, instead of causing the conditions that were the subject of the complaint, the product was actually a remedy for them. As a result of the researches the proprietor found not only that his product did not and could not cause the infection and other untoward symptoms, but that there was a place for it in a field where heretofore he had no idea that it would be useful.

Pastes for whitening the under side of the nail-tips usually consist of a very pure form of zinc oxide

compounded with glycerin, white vaseline, or lanolin. They usually amount to a peculiar type of paint resembling in some respects the pastes used by the portrait-painter.

In discussing the character of the numerous face and body creams, reference was made to the so-called bust-developers and skin foods. Some of these preparations, when designed for increasing the rotundity of those parts of woman's anatomy which determine her attractiveness from the point of view of perfect form and development, contain a considerable proportion of cacao butter, in addition to the usual greases and gums characterizing creams of this type. Cacao butter is obtained fom the chocolate-bean, not from the coconut. It is also called oil of theobroma, and when pure is a pale yellowish-brown opaque substance with a mild odor suggestive of chocolate. It melts at the temperature of the human body, and hence its presence in creams and skin foods tends to increase their softness when applied, and possibly the rapidity with which they are absorbed into the tissues.

Next to a comely face set off with a natural profusion of healthy hair, the indispensable adjuncts to complete attractiveness in woman are shapely legs and feet, duly proportioned to the individual stature. Extraordinary development in the shape of the extremities or the form of the body, whether it be subnormal or prodigious, is in large measure due to the habits of the individual and the general state of health. Women of sedentary ways and nervous temperament, with the customary accompanying ailments, or the lethargic type with a proneness for over-indulgence in food and motor-cars, cannot expect to compete in

physical attractiveness with those who respect the mandates of nature as to diet, dress, and exercise.

Feet and ankles conforming to the physical symmetry are naturally a desideratum. The consummation of this desire depends considerably upon the care that is taken to fit the shoes to the shape of the pedal extremities. Low pumps and high heels are out of place on a tramping expedition, just as hob-nailed boots would be in a ball-room. But fashion can be adapted to form without sacrifice of style, and if such an attitude is observed with intelligence, it will mean freedom from weak joints, fallen arches, calluses, and ingrowing nails, with all their attendant discomforts.

Most of the foot powders are simple combinations of talc or boric acid alone, with mild antiseptics such as thymol and camphor; or they may be of more complex nature, and include zinc stearate or zinc oxide, salicylic acid, alum, and tannic acid.

Corn-removers are of various forms, but they usually depend on the same ingredients for their efficacy. Salicylic acid is an invariable component of all these preparations, and extract of cannabis sativa is often present. The salves are built up on a base of vaseline and lard stiffened with wax; the liquid removers contain the ingredients dissolved in collodion; and the plasters depend for adhesiveness on lead oleate, resin, or burgundy pitch. The medication of corn plasters is usually in little doughnut-shaped receptacles of felt, which are held in place by adhesive tape. A well known brand of corn plaster was at one time under review in Dr. Wiley's laboratory, when the doctor happened along and requested a specimen for his

personal use. A few weeks later, when asked as to the results, he reached into his vest pocket and withdrew the package intact, remarking, with a smile, that it made no difference where you wore them—his corn had disappeared!

Seriously speaking, however, these aids to the comfort of the feet will, when properly and consistently applied, go a long way toward removing ordinary calluses, and sometimes the extremely disagreeable and painful nodosities, "charley-horse" and the like.

To the numerous toilet waters and colognes that provide the finishing touches to the toilet we shall devote but a few paragraphs. The perfumer's art is a gift, and to become proficient in its execution years and years of practice and experience are required. Delicate and subtle perfumes result from the careful blending of the fragrant volatile oils obtained from fresh blossoms and leaves. Some of these oils or essences are separated from the flowers by a process of distillation, whereby live steam is forced through masses of moistened petals. The vapors are condensed, and, since the fragrant oils are not soluble in the water, they form a layer on the surface. When a sufficient volume has collected, it is drawn off and subjected to further refinement if necessary.

Some oils are bottled for direct use in concentrated form. The oils of violet and rose are examples, the latter having been for centuries an article of commerce under the name of attar or "otto" of roses.

Some of the more delicate perfume oils cannot be separated by distillation from the flowers without damaging their character, and they are therefore obtained

by a process known as enfleurage. Layers of fresh blossoms alternate with layers of grease of high purity in a carefully constructed pile, the aroma of the flowers being gradually absorbed by the grease. When there is no more perfume left in the blossoms, the grease is removed, and either used with a fresh batch of flowers, or, if saturated, is packed away for the subsequent use of the perfume-maker.

The great bulk of the concentrated oils and essences that go to make up the multitude of perfumes, colognes, and toilet waters on the market are, however, of synthetic origin. They consist of substances belonging to the great organic family of chemicals. Some belong to the order of alcohols, others to the order of aldehydes and ketones, and still others to the esters, phenols, and phenol ethers. Coal-tar and fusel oil supply the basic constituents for a large number of these synthetic perfume concentrates. An artificial oil called ionone, simulating to a high degree the odor of violets, is made in large quantities, and most of the cheaper violet perfumes depend upon it for their characteristic aroma.

In compounding the actual perfumes, the artisan takes the natural or artificial oils and the enfleurages, combines them in proper proportions, and dissolves the formula in alcohol. The mixture is colored if the specifications of the preparation call for it, and then set aside until it has aged sufficiently. The clear liquid is finally filtered off from the settlings, and is then ready to be bottled for the trade.

In some colognes the aromatic balsams of Peru and tolu, gum benzoin, storax, opopanax and the animal

secretions, civet, ambergris, and musk, feature as component parts of the blends. Musk is a powerful perfuming agent, and such an infinitesimal quantity is required to manifest its presence that a particle will permeate the air of a room with its aroma for a year without any demonstrable loss in weight.

The increase in the consumption of cosmetics and toilet articles in the last quarter century is attested in the decennial census reports and the statistics concerning the annual consumption of alcohol in specific industries.

Beauty parlors and hair-dressing establishments occupy the most favorable locations on the fashionable avenues of our large cities. Their equipment is often lavish, and they are thronged with patrons from morning until night. Most shops use their own preparations, though but a small number actually engage in manufacturing them. In fact, the manicurists, masseuses, and hair-dressers seldom know the composition of their own preparations. But, whether they feature among the applications of the beauty parlor or the ablutions of the boudoir, these perquisities of the bath-room and kimono stage of the daily routine are, in the main, simple preparations, harmless in character, and capable in many cases of supplying the essential reinforcements to those features of womankind on which her physical attractiveness depends.

CHAPTER XIII

HAY FEVER: THE MALADY OF STRENUOUS AMERICA

Of all the maladies to which the human race is addicted, none bespeaks the temperamental character of the North American Caucasian more thoroughly than does that periodical affliction, hay fever. Its peculiarity rests not alone in its annual visitation, but in the fact that it is endured by the great mass of the afflicted without any consistent recourse to curative treatment, and, though it racks and tears the sufferer with its pestilence, he seems to be perfectly sound when it is gone, and goes through the same experience year after year without any apparent undermining of his constitution.

Ever since its existence became recognized, it has possessed a sort of community interest, and its subjects have delighted to assemble in conclave to condole with one another over its manifestations. Unless complicated by obscure conditions or chronic afflictions, it seldom places one in confinement, though it may seriously handicap the performance of one's daily occupation and interfere with and often prevent the indulgence in customary sports and recreations.

Hay fever is in a class by itself as a malady, and because of the popular interest in its life history we shall devote a few paragraphs to detailing what it is and what has been done to control it.

Many persons labor under the assumption that hay fever is nothing more than a magnified cold in the head. It is nothing of the sort. It is as different from a cold in the head as is measles from prickly-heat.

Some people, during the season when it is fashionable to have hay fever, experience the discomforts of an overflowing ocular liquid and an irritation of the nasal passages, with the usual excess of mucoid secretion, due to the microbe-infested dust prevalent at that period, and proudly announce that they are smitten. But this is not hay fever.

With others a streptococcus infection, due to an unconscious lowering of the constitution, may develop in a membrane and manifest an acute recurring coryza or a hard cold during the late summer months. They announce with assurance that they have "caught" hay fever. But this is not hay fever.

The genuine hay-feverite views with scorn the assumption of these interlopers. He knows when he has a cold in the head or an infection of the tonsils, with the accompanying nasal symptoms, and that hay fever is not akin to them at all. He knows that punctually with each recurring season, between certain prescribed dates, the visitation will descend upon him with the regularity of a tax-collector; that, unless he is fortunate enough to be able to afford the luxury of a migration to a region where the anaphylactic agent to which he is susceptible is non-existent, he will resign himself to its discomforts for the period of a month or two; that his nights will be filled with anguish and for the duration of the attack he will intermittently join the nocturnal watch and resume his annual communion

with the owls and whip-poor-wills. He knows, too, that he will resort to any new remedy that is suggested for his relief; for the hay-fever victim is a good sport and will try anything once. The variety of things that have cured the fake hay-fever patients is legion, and these pests, with fiendish persistence, delight in detailing the symptoms of their false diagnosis and in extolling the virtues of their sovereign remedies.

Hay fever is due to an anaphylaxis of the mucous membrane of the nasal passages and, to a certain extent, of the bronchial tract. In plain language, anaphylaxic means hypersensitiveness of the skin tissues to some cause that would be inactive in the case of a person not possessing the idiosyncrasy. In hay fever the excitation is brought about by the toxalbumins occurring naturally in the pollen of certain plants.

These toxalbumins are nitrogenous organic bodies of undetermined composition, but presumably complex in their structure. Their action on the human tissues and membranes is irritant. Some persons are more susceptible to their influence than are others, and some react to them so violently that the manifestations take the form of a malady lasting as long as the pollenating season. It is to the symptoms exhibited by the latter that the designation hay fever is given.

Flowering plants begin to distribute their pollen early in the spring. By midsummer the atmosphere is permeated with the minute particles, and at this season anaphylactic symptoms are known as "rose cold," though it is doubtful whether rose pollen is a factor of any great moment in the cause of the

annoyance. The pollens of the coniferous trees and the grasses, especially timothy-hay, are believed to be contributing agents to the manifestations of hay fever appearing in the early summer. Later on the goldenrods contribute their influence, though, like the roses, it is probable that their maliciousness has been overestimated. The late blooming wild sunflowers are also credited with yielding an irritant pollen. But the worst offenders of all are the two ragweeds. These pariahs in the scheme of nature flourish everywhere, crowding out the other growth along the roadsides and springing up in unused fields, which they quickly convert into a rank and sneeze-provoking jungle. The common ragweed (*Ambrosia artemisiafolia*) has a bushy growth, and seldom surpasses the height of four or five feet; but the giant form (*Ambrosia trifida*) pushes up to an altitude of ten feet or more, waving its candelabra arrangement of bloom mockingly at the observer, as if it thoroughly enjoyed the widespread discomfort caused by itself and its more stunted cousin.

The mental processes of the hay-fever addict vary from resignation to supine hope as the period for the onset of the malady approaches—resignation in the case of the long-term sufferer, and hope in the recently initiated that he may escape this time. Even the "lifer" wonders if he may run a few days past the customary date, and if he is of a methodical turn he refers to his diary to see when the affliction struck him the year before. Even he, though resigned to his fate, may contemplate the possibility of a lighter attack than usual. Then one and all consult the almanac to

determine the probable date of the first sharp frost, in the belief that they may figure the duration of their tribulations on the basis of its appearance.

But here is where they make their big mistake, because frost has nothing to do with the ending of the hay-fever season. The hay fever of autumn depends entirely on the duration and profuseness of the pollenating period of the ragweed, and until the pollen grains cease to exude into the air the acute symptoms will not subside. In some localities the ragweed gets through with its generative processes in a shorter time than it does in others, and sometimes a black frost will put the quietus on all growing vegetation at an abnormally early date. But the usual white frosts that come with September do no more than retard the nocturnal activities, and under the influence of the daylight rays the blossoms again pour forth their emanations.

As the expiration of the final days of grace approaches, the thirty-third-degree hay-feverite watches the swelling buds of the ragweed with a fascination surpassed only by that of the little child awaiting the appearance of the sprouts in his first bed of crocuses that were put into the ground the preceding autumn. Then, from a man possessed with a free and unhampered breathing capacity, he awakes one morning to find himself a sneezing and membrane-congested individual in the throes of the first acute stages of the malady.

In its inception the irritation involves the mucous membrane of the nasal passages. The inflammation of the erectile tissue quickly develops a permanent

tendency to congestion, which alternately closes one nostril and then the other. This peculiarity is characteristic of hay fever. For hours at a time one side of the nose will be closed as tightly as if the flesh had grown across the orifice, the opposite passage meanwhile being free. Then the pressure will be relieved, and the affection will shift to the other nostril. The sensation of an accumulation of mucous, recalling the features of a hard head cold, is ever present; but the relief that follows the clearing of the head does not occur in the case of hay fever. The discharge is continuous, but its removal does not affect the congestion.

For the first few days the attack is confined to the head, the anaphylaxis involving the eyes, which, especially in the morning, overflow with copious streams of tears. Then it extends to the bronchial and laryngeal tracts, the voice becomes thick, and a nocturnal cough appears. The case is now at its height. From this stage until its subsidence, the permanent symptoms are interspersed from time to time with an uncontrollable itching in the ears and intermittent spasms of like nature in the back of the palate. The whole bodily frame is shaken with paroxysms of sneezing, especially in the early morning on rising, or when in close contact with the source of the contributing causes.

When the malady has the sufferer firmly in its grasp the asthmatic spasms make their appearances. This is the disagreeable feature that makes night hideous. It becomes impossible to recline at full length, and often sleep is impossible. The breathing is labored

and difficult. The unconscious satisfaction imparted by the usual deep inhalations of perfect health is substituted by an unrequited desire to expand the diaphragm. One may struggle for breath for hours; then the paroxysm subsides, and with the coming of daylight the world takes on a different aspect. When an individual becomes a perennial sufferer in the above program, he has the right to consider himself enrolled in the hay-fever fraternity.

Asthma is an affliction that affects a great many people who do not show seasonal symptoms of hay fever. Confirmed asthmatics will experience the manifestations of their affliction at recurring intervals throughout the year, and often the true hay-feverite will, out of season, be smitten with an occasional attack of asthma. While asthma is usually concomitant with hay fever, it results also from a variety of other causes. Its treatment follows a careful study of the individual case, the determination of the predisposing influences, their mitigation by medical aid, and, if due to an external excitant, the inertization of the offending influence.

Ways and means for relieving the agonies of hay fever and for effecting a permanent cure have occupied the attention of expert talent for many years. Thus far, no universal medical specific has been discovered, though great expectations are attached to the immunization treatment with pollen solutions, of comparatively recent exploitation.

No doubt the best solution of the individual problem is a sojourn in a region devoid of the particular vegetative growth responsible for the attack. Re-

course to this indulgence is possible only for persons of affluence or those who can afford to absent themselves from their customary occupations. The rank and file of the fraternity must either resign themselves to their affliction or transfer their abode to a more salubrious environment.

Many people experience complete immunity at high altitudes. This is due to the fact that by far the greater number of victims are sensitive to the ragweeds, and these are plants of the lowlands. The White Mountain region is a favorite resort for those desiring to escape the annual plague. In this section above a certain altitude the ragweeds are unknown, and here the majority of the affected can go through the season in peace and comfort. It is only when the warm breezes sweep up from the lower valleys, bringing an accumulation of pollen from the lowland vegetation, that discomfort is experienced. But the attacks are usually of an attenuated form and disappear with the change of the wind.

The goldenrods flourish in the higher altitudes as profusely as they do in the lowlands. The fact that most people who exhibit a typical hay fever at the lower levels are immune in the mountains where the goldenrods are indigenous points strongly to the comparatively slight influence that this genus has on the prevalence of the trouble.

Some sufferers claim immunity at the seashore, and others seek and apparently obtain relief through extended ocean voyages. Mental suggestion is credited with aiding many cases, but it usually transpires that those who have the time to indulge in these metaphysi-

cal diversions also take pains to spend their vacations in the mountains.

Many specific remedial agents have been suggested and tried, and often the temporary relief of some of the obnoxious symptoms of hay fever has followed their use. At one time a popular course of treatment held the center of the stage and was credited with effecting some remarkable cures. It is probable, however, that those who experienced permanent benefit were asthmatics instead of genuine hay-fever victims. The treatment included a dozen or more different articles, including the iodides, which are recognized as being efficacious in asthma, and an extract of the Queensland asthma herb, together with various local applications, a general tonic, and a laxative. There was something to do every hour of the day, so that one almost needed to take a vacation in order to indulge in the routine of the treatment.

Cauterizing the nasal membranes, anesthetizing by means of numerous atomized sprays featuring cocain, removal of cartilage and bony growth, resort to copious draughts and irrigations of sodium bicarbonate, all have been heralded as solutions of the problem, and have been relegated to their proper places in the scheme of symptomatic treatment.

When adrenalin was introduced, it was hoped that this remarkable substance would prove to be the long-sought desideratum; but again the hopes of the enthusiasts were blasted. We may well pause at this point to devote a few words to adrenalin, because its discovery is one of the outstanding features in the history of the materia medica, and because it occupies an un-

challenged place in its particular field of usefulness.

It has long been known that in certain organs situated just over the kidneys, known as the suprarenal glands, there existed something that had a remarkable effect on the blood-pressure. When solutions of these glands were introduced into the circulation, the pressure of the vital fluid would rise in a marked degree; when applied to open wounds the hemorrhage would cease; and when swabbed on an inflamed surface, the sanguinary color would disappear.

It remained for Takamine, a Japanese chemist, working in New York in the late nineties, to separate from the suprarenal glands of sheep the pure principle to which these effects are due. It was named adrenalin, and immediately jumped into a popularity that has never waned. Some scientists call it epinephrin, but to the medical profession it is known as adrenalin. It possesses certain properties characteristic of the alkaloids, forming salts with acids, one of which, the hydrochloride, furnishes the preparations used in the medicinal world. It is unstable in ordinary solutions, especially when exposed to the oxygen of the air. But because it is extremely powerful in its action it must be used at great dilution; hence the hydrochloride is marketed in dilutions of one part in a thousand of distilled water, the solution being preserved with chloretone and saturated with carbon dioxide, an inert gas.

Many hay-fever victims derive considerable benefit from the application of very dilute sprays or ointments of adrenalin hydrochloride. Others, while obtaining immediate relief, later experience increased congestion and extra-intense paroxysms of sneezing.

At the present time the attention of the medical profession is occupied with the consideration of the vaccine and pollen treatment as a means for aborting the onset of hay fever. The theory of this remedial practice, and the means adopted to produce the vaccine, have been detailed at some length in a preceding chapter.

Before submitting to the treatment, which begins eight or ten weeks before the attack is due, the sensitization of the patient is established. This is for the purpose of ascertaining the particular pollen to which he is susceptible. Several scratches are made through the epidermis on the under side of the forearm, just below the elbow, and a drop of the pollen extract of first one hay-fever weed and then another, is applied. The patient usually shows a marked response to the particular pollen to which he is anaphylactic. A weal soon develops around the site of the scratch, puffing up to a considerable magnitude, and often accompanied by a noticeable irritation.

Having ascertained the identity of the predisposing pollen, solutions of a concentrated form of its toxalbumin are injected hypodermically at semi-weekly intervals up to the time the attack is ordinarily due. Then they are stopped. In the beginning the injections are highly dilute, otherwise the patient will show all the customary symptoms of an attack of hay fever. But, as tolerance is established, higher potencies are administered.

As yet there are insufficient data to establish the permanent value of this treatment. In some instances no relief has followed, though this may have been due to an error in the diagnosis and not to the experiment.

But in many cases immunity has been established. Just how long this immunity may be expected to last is uncertain. Some observers believe that it becomes weaker as time goes on and should be reinforced annually; others find the immunity increasing from year to year.

When all is said and done, hay fever is a peculiar malady and reflects the temperament of the American to a degree unrivaled by any other idiosyncrasy of the race. That which benefits one individual often appears to be ineffectual for another. Those who have the time and leisure will try one means of relief and then another, and never obtain any permanent good from any. Their greatest relief seems to come from discussing in a group of similar victims the various phases of their malady.

The only treatment that appears to promise permanent results, aside from escape to a salubrious climate, is the recourse to pollen injection, and that is a long-drawn-out affair, and often ends in discouragement. The average American is not prone to submit willingly to anything savoring of procrastination, no matter how lazy he may be individually. He wants to see immediate results. Hence the bromidic remark, so often heard: "If anyone could invent a cure for hay fever, he would make his fortune."

CHAPTER XIV

LEGISLATION AND ITS EFFECT ON THE DRUG BUSINESS

In several of the foregoing chapters references have been made to the application of various pieces of legislation to the conduct of the affairs of the medicine manufacturer. We have noted, in passing, that apprehension on account of the widespread and indiscriminate use of opium and other narcotics brought about the passage of the Harrison Anti-Narcotic Act. We have touched on the work of Dr. Wiley in his administration of the Food and Drugs Act, also on the difficult task of the officials of the Bureau of Internal Revenue in handling the alcohol question as it applies to the medicine industry.

It remains for us to devote a few words to the reactions of the different branches of the drug trade to the important pieces of legislation that relate to their affairs.

Within the last two decades the drug and medicine business has been almost revolutionized by this legislation. Although little appreciated, perhaps, by the casual observer, it has been of vital significance to the trade in the adjustment and conduct of its affairs. The revolutionary changes have resulted in large part from a general concern for the conservation of the public health and realization of the advancement of business

ideals. It has been, in the main, a wholesome movement, though the rules and regulations necessarily accompanying it have been irksome, and by some the new system has been hailed as a paternal and meddlesome interference in personal affairs.

The most important of these measures, from the point of view of the trade as a whole, are the Food and Drug Act, popularly known as the Pure Food Law, passed in 1906; the Anti-Narcotic Act of 1914, known as the Harrison Law; and the Volstead or Prohibition Act of 1919.

Concurrent with these vital pieces of legislation, there have been enacted a number of lesser measures affecting, for example, the manufacture and handling of serums and vaccines; the control of the traffic in smoking opium; the shipping of poisons through the mails; the use of denatured alcohol in certain forms of medicines; and the extension of the postal regulations to the curbing of fraudulent methods of exploiting fake remedies.

The legislation above mentioned has been passed by Congress, and in its scope affects the nation as a whole. There have also been passed a number of similar laws in the several commonwealths, and municipal ordinances for handling local conditions.

As a rule, the federal leglislation has been intelligently drawn, with the view of causing no unnecessary hardship upon the legitimate trade. In some of the States the laws leave little to be desired, and, where they affect the traffic in foods and drugs, are modeled in general after the federal acts. Some States had food and drug laws before the national legislation was

passed, while probably all of them had on the statute-books enactments regulating the practice of pharmacy.

The laws in the various States have often exhibited conflicting points, so that a product might bear a label that was legal, as to its compliance both to the national law and to most of the State acts, and yet be illegal in one or two States.

Greater conflict has occurred among the municipal ordinances. Over-enthusiastic health officers are continually drawing up regulations reflecting their individual reactions toward drugs and medicines, with little or no regard to the saner legislation under which the trade as a whole has been functioning for many years. This phase of the general movement is perhaps the most disconcerting, because it often transpires that, in order to comply with certain ill-advised regulations in a particular city, a manufacturer is obliged to change the character of his product and draw up a special form of label if he wants to sell his goods there.

The medicine business to-day is not in any sense local. A manufacturer in Detroit will sell his wares in every State in the Union, and in every city, town, and hamlet from the Atlantic to the Pacific, and from the Rio Grande to the Canadian border.

Unification of State laws has been attempted through the coöperation of the national government, and considerable progress has been made in reaching the ends sought.

The municipal nut is a harder one to crack. Local conditions influence the situation, and political considerations often subordinate the merits of the case,

with the result that unnecessary and perhaps ridiculous measures are sometimes incorporated into the legal code.

A brief insight into the conception and realization of the federal leglislation is instructive as well as interesting. The more important of these laws have come into existence either through a widespread popular movement, the interests of which have been fostered by some outstanding individual, or they have been inspired by an official in the employ of the government, who has ridden his hobby with such a wonderful display of horsemanship that eventually he has won the admiration of the populace or the solons of Capitol Hill, and through their influence his labors have been rewarded by the passage of a law embodying his thesis.

The Anti-Narcotic Act and the Prohibition Law are examples of the former class, Hamilton Wright being associated with the movement for the control of narcotics, and Wayne B. Wheeler for sponsoring and putting across the Prohibition legislation.

The Food and Drugs Act and the Insecticide and Fungicide Law are examples of the second class. Years ago there came to the Bureau of Agriculture in Washington a man in the prime of life, who with six others, comprising the entire chemical staff of the Bureau, laid the foundation of the present Bureau of Chemistry. This man was Harvey W. Wiley. There was then no Department of Agriculture. That branch of the government service, which was later to develop into a full-fledged department, was known as the Bureau of Agriculture. It originated as a division of the Patent Office, but eventually was divorced from that

association, and, at the time Dr. Wiley came to Washington, was leading an unattached and somewhat nebulous existence, responsible apparently only to the President. The Department of Agriculture came into being nineteen days before the close of Cleveland's first term. Dr. Wiley's early efforts centered on sugar and sorghum. Gradually his work involved other subjects, and in time the study of feeding stuffs and then foods in general became necessary, so that when the extensive research on foods and their adulteration began to show the widespread practices of the manipulators of the supplies for our breakfast-table, Dr. Wiley plunged headlong into his life-work, and the foundations of the Food and Drugs Act were laid.

Long before this time, however, the old Bureau of Agriculture had been transformed into a department, and the chemical laboratory had passed through the adolescent stage of a division and was a full-fledged Bureau of Chemistry.

While Wiley was riding toward his goal, there came to Washington and became attached to the Bureau a young man named Haywood. He was an indefatigable and tireless worker, and soon found his hobby among the numerous pastes and powders designed to protect the growing crops from the ravages of bugs, insects, and fungous disease. He discovered that there was as much need for improvement in the character of the articles intended to protect the farmers' crops from insect pests, and his cattle and poultry from ticks and lice, as Wiley found in the food supplies.

Dr. Wiley's persistence and intrepidity eventuated

in the passage of the Pure Food Law, and a few years later Haywood's efforts were crowned with success when the Insecticide and Fungicide Act was enacted.

These two cases are typical of the course followed in the development of legislation originating within governmental offices.

Of all the legislation affecting the medicine business, none other has been so far-reaching as the Food and Drugs Act.

Unquestionably there was vital need for this law. We have already discussed the inter-relation of the several branches of the drug trade, and the dependence of one factor on the operations of the others. As the volume of business increased and the various branches of the industry became more competitive, unscrupulous methods arose, seriously handicapping those who were endeavoring to maintain high ideals of business integrity. Crude drugs were adulterated with inert vegetable matter or loaded with sand and gravel. Powdered drugs were sophisticated with foreign material that could not be detected by the ordinary methods of examination. Substitution was a common practice.

Higher standards were maintained by the manufacturers of the medicinal chemicals, but even among the medicine-makers there were many firms whose products were below standard. Thus was created a situation that was not only disheartening to those dealers and manufacturers who were trying to do a legitimate business, but a grave menace to the public health.

The physician demands dependable remedies for combating the numerous emergencies he is called upon

to face. It is not his province to test the potency of his supplies, either of those he dispenses or of those he prescribes. He depends upon the purveyor for the character of the medicine. If he requires a tincture of digitalis to combat a crisis, it must be a potent preparation made from an active drug. He can accept no substitute. There can be no failure on account of the adulteration of the medicine he prescribes. Nevertheless, if the digitalis leaf is not of proper quality, if the tincture is inert, his results are negative and his case is lost.

Previous to the enactment of the Food and Drugs Act, except in the statutes of a few of the States, there was no way by which the quality of the crude material and the finished medicines made therefrom could be regulated. To be sure, there were standards prescribed by the Pharmacopœia and National Formulary, and the reputable houses made their medicines in compliance therewith. But competition was keen, and through various sources the market was flooded with substandard supplies.

Among the package medicines sold directly to the public great abuses existed. Scores of them were pure fakes, while most of the labels bore impossible claims or statements of an exaggerated character. These conditions reacted unfavorably against the meritorious remedies of this class, of which there were many. An indiscriminate propaganda was inaugurated, involving all "patent" medicines and proprietaries, which has continued to this day.

The events leading up to the passage of the Food and Drugs Act were hectic in the extreme. Immense

sums were spent to defeat it; but on June 30, 1906, the bill, having passed both houses of Congress, was signed by President Roosevelt, and became the law of the land. Its constitutionality has since been fixed by the Supreme Court, and its clarification, in so far as the medicine trade is concerned, has been fixed by the Sherley Amendment, which amplified the provisions relating to its application to false and fraudulent claims in the matter of labeling.

Many interesting situations developed in the early days of its administration. Fraudulent practices that had become tradition in the importing industry were exposed and corrected. Asafetida, which had theretofore been heavily sophisticated with pebbles and dirt, was made to discard these encumbrances. Decorated saffron and a factitious substitute called feminella, composed of calendula florets colored with a coal-tar dye and weighted with oil, were apprehended, and either made to be divested of their disguises or excluded from the country. Opium balls, concealing chunks of lead and other foreign burdens, were made to reveal their false gravity. Immense importations of ground olive-stones, when questioned, were found to be intended for the purpose of adulterating powdered drugs. Shipments of roots, barks, and leaves carelessly packed and full of dirt, inert sticks, stems, chicken feathers, and other junk, were stopped at the ports of entry, and either sent back to their places of origin or kept in quarantine until they were renovated. A howl went up from the crude-drug trade; but, coöperation being more profitable than antagonism, the protests eventually subsided.

As matters stand to-day, the crude-drug supplies entering our ports from foreign sources are, in the main, relatively free from the débris that ordinarily accompanied the shipments of a decade and a half ago.

Among some of the interesting fraudulent remedies that fell afoul of the administrative officers, may be mentioned one claiming to exhibit the virtues of beaver oil. It was recommended for all the bodily pains and inflammations, from headache to chilblain. On analysis it was found to consist of sassafras oil and the essential hot principle of capsicum (red pepper) dissolved in gasoline.

Another remarkable offering, for the treatment of pimples, blackheads, rash, blemishes, sunburn, and chapped hands, called "skin food" by its exploiters, was found, on examination, to consist of epsom salts colored a vivid shade of pink. Possibly it was correctly named "Skin" food, but in the vernacular.

Humbug Oil, possibly a truthful title and expressive to say the least, for the relief of diphtheria, on exposure was shown to consist essentially of a mixture of turpentine, linseed oil, and ammonia, with ammonium salts and a volatile alkaloid dissolved in the liquid.

One of the most vicious types of fake medicines flourishing at that period was a cancer cure that claimed to possess the virtues of radium. The treatment was found to show no evidence of radioactivity, and a fluorescent manifestation, which the promoter baldly claimed to be due to radium, was caused by a minute quantity of quinin, which has the property of exhibiting a bluish fluorescence in acidulated water.

The exaggerated claims in the labels and circulars

of medicines sold directly to the public were not confined to those that were manifestly fraudulent. To a considerable extent they featured the presentation of meritorious proprietaries. The natural result of this condition was that all preparations intended for popular sale were considered to be of the same ilk, so that most of them became involved in the investigations that were instituted after the law went into effect. But those remedies possessing any excuse for their existence soon established themselves under the new régime. The general house-cleaning that took place freed them from the odium previously attached to the patent-medicine industry, and their true significance in the nation's economy was recognized.

The Food and Drugs Act has brought about an improvement in the quality of the crude material that enters into the composition of medicines; it has reduced to a minimum the traffic in substandard remedies; it has made it encumbent on the manufacturer to label his wares so that there will be no doubt about what they will do, and, if the ingredients are enumerated, to declare them properly; it has been instrumental in destroying the fraudulent exploitation of worthless concoctions; and it has defined the status of the legitimate proprietary.

The salutary results of the Pure Food Law are appreciable to larger extent perhaps, in their public aspect, than in their relation to the direct interests involved. In so far as the administration of the law applies to the ethical conduct of the numerous branches and ramifications of the drug trade, its success or failure depends on the tolerance and resourcefulness of

the administrative officials. The menace of the technical hobbyist ever dangles over the legitimate business, like the sword of Damocles. The working out of the provisions of the law during its fourteen years of existence has produced a state of neurotic apprehension in the trade, due to the uncertainty of its application to the various interests involved. This is not a criticism of the law itself, nor of those who have been honestly and conscientiously concerned in its enforcement. The scientific enthusiast (and this law is, in the end, administered by scientific talent) often loses sight of all aspects of his subject other than the particular point of view he has assumed. The result is that, in attempting to gain his point or to enforce his idea on the drug and medicine business, he runs afoul of facts and conditions of which he knows nothing, and perhaps, by belittling their significance in order to push his advantage, unwarranted hardship is inflicted.

Take, for example, the effect of this attitude on the manufacture and sale of medicines. It often happens that in a circumscribed region certain types of remedies are popular with both the physician and the public. Their employment outside of this region may perhaps be slight or even unknown. The facts of their use may have been of casual knowledge to the profession at large, or perhaps, on account of the controversial opinions prevalent in the medical world, their value in general may be ridiculed. But the recognition of debatable therapeutic ideas in opposition to a well grounded medical usage should have no place in the impartial administration of a law as far-reaching in its effects as the Food and Drugs Act.

If a drug or a remedy or a group of remedies can be shown to have alleviated diseased conditions, or to have brought about a restoration to health, no obstacle should be placed on their legitimate use. Unfortunately, scientific hobbyism has sometimes marred the administration of the law, and for this reason the trade in general may be said to have acquired an attitude of tolerant contempt consequent to its operation, and to be continually in a state of neurotic apprehension.

A simple illustration or two will show the status of the case. Not long ago it transpired that, while discussing with a group of the administrative scientists the reasonable limits to which one might go in developing a remedy for a definite state of ill health, the question was asked whether a certain drug, with well established properties, might not be added to the formula in order to round out its efficiency. The official on whom the final decision rested promptly replied that he had *never heard of that drug;* and yet, it was one described in the medical and pharmaceutical text-books and its therapy has been well established.

On another occasion, when administrative prejudice had been directed against one of the most widely used drugs in the materia medica, an advocate in its behalf offered to put the question of its effects, then under debate, to a group of scientists to be selected within and without the government staff. In answer, the official said that it mattered not if all the professional opinions in the world were contrary to his—the attitude and policy that he had assumed would remain unchanged.

These instances are not cited in a spirit of criticism. Our exposition is concerned only in outlining the

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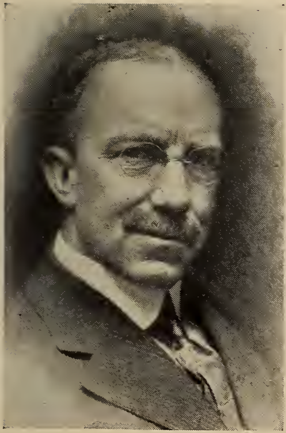
HARVEY W. WILEY

Responsible for the Food & Drugs Act Popularly Known as the "Pure Food Law"



WAYNE B. WHEELER

Identified with the Passage of the Prohibition Law

HAMILTON WRIGHT

Author of and Responsible for the Passage of the Anti-Narcotic Law

BRANCH OF COCA SHRUB

A COCA PLANTATION IN PERU

Photographs by O. F. Cook. Courtesy and copyright by National Geographic Society, Washington, D. C.

effects of legislation on the drug business and in noting the causes of existing and undisputed conditions.

Somewhat in contrast to the uncertainty that has characterized the administration of certain features of the Food and Drugs Act is the straightforward policy shown by the officials in charge of the Insecticide and Fungicide Law. While this legislation is concerned primarily with the control of the traffic in preparations used for destroying insects and fungi, it extends also to antiseptics and germicides. Both of the latter are made and sold by the drug trade. It has been a very simple matter for a firm, desirous of complying with the law or of obtaining direct information on an obscure or doubtful point of labeling, to receive the help and coöperation of the Insecticide and Fungicide officials. The attitude assumed by the Haywood Board has been a distinct help to the drug trade and its individual members, whenever they have sought its advice and coöperation.

While the Food and Drugs Act has been effectual in curbing many of the objectional practices menacing the drug business, there were certain types outside of its jurisdiction, and it is in order to refer at this point to the activities of the postal authorities in their relation to the progressive movement in the general revolution. The regulations affecting the operations of the mails provide for the exclusion of matter of fraudulent character, especially if the schemes include the taking of money under false pretenses. Numerous deceptions were being practised by means of newspaper advertising and correspondence. The projects in-

cluded cures for cancer, drunkenness, the dope habit, consumption, rupture, and similar vital ailments. The fraudulent features of the exploitation occurred in the advertising or in the correspondence, whereas the package of medicine, in many cases, contained nothing objectionable except, perhaps, the product itself. It must be understood that under the provisions of the Food and Drugs Act, no action can be taken against a preparation or a firm handling it, unless it goes from one State to another, and unless its label contains false claims and misrepresentations, or the circular accompanying the package features similar material. Owing to this situation, many products were immune from the provisions of the law, because their exploiters were clever enough to confine their utterances to correspondence and the press. But Nemesis finally overtook the exploiters in the shape of the Post-Office inspector, and fraud orders, with consequent exclusion from the mails of their correspondence and advertising, became the order of the day.

One of the cancer cures put down by the Post-Office authorities consisted of a combination treatment of several so-called "prescriptions" which were found, on analysis, to consist of a clay poultice like antiphlogistine, a can of vaseline, a bottle of sarsaparilla compound, a tablet composed of talc and sugar, and an embrocation featuring the fixed oils of cotton-seed and sweet almond. Another widely advertised treatment consisted of a small drug establishment with two dozen or more articles and preparations. But perhaps the most interesting fake exposed by the heartless officials depended for its virtues upon a mixture of

sand and clay. With this it promised to draw the "cancers" out through the pores, and its promoter glibly asserted that if a lump of butter were placed on one side of a two-inch plank and the absorbent material on the other, the grease would be drawn right through the pores of the wood.

Space will not permit of a detailed account of the alleged cures for consumption, the drug habit, drunkenness, obesity, and rupture that were exposed by the postal authorities. The detail of collecting and examining these fraudulent remedies has been carried out at the Bureau of Chemistry in coöperation with the Post-Office Department. The credit for the successful outcome of the work is due, in a large measure, to Lyman F. Kebler, who, with untiring persistence, has methodically pursued each and every questionable nostrum, as its lurid presentation has blazoned forth in the advertising columns, until there is slight inducement for continuing this method of exploitation in a wholesale fashion. Through the persistent efforts of these workers, the drug trade has been shorn of a great encumbrance, while its tone has been markedly elevated since these impossible schemes have been put down.

The Anti-Narcotic Act of 1914 sounded the death-knell of most of the dope-habit treatments formerly dispensed indiscriminately by a group of so-called "sanitariums" scattered over the country. The treatments usually consisted of the same narcotic drugs that the addicts were trying to break away from. The Food and Drugs Act had little or no effect on this practice, other than to require declarations on the

label of the quantity of narcotic drug contained in the bottle. But the Harrison Law was sufficiently drastic in its provisions to prevent the further traffic in those preparations.

The legitimate drug trade was never disposed to further the indiscriminate sale of opiates and cocain; hence the advent of this legislation was effectual in freeing it from the possible odium of being the means of making the evil possible. Except for the necessity of keeping an additional volume of records demanded by the regulations, the trade has experienced no great inconvenience.

The recovery of morphin from opium and of cocain from coca leaf, and the conversion of these alkaloids into pure salts acceptable to the maker of medicines and the dispensing physician, has always been a lucrative feature of the manufacturing industry. To what proportional extent it figures in the aggregate business of this branch of the drug industry it is somewhat difficult to estimate, but it is not inconsiderable. In any event, whenever steps have been taken to impose further restrictions on the importation of the crude drugs, or to place closer supervision on their journey in the direction of the ultimate consumer, the manufacturing chemists have sought aggressively to conserve their prerogatives and prevent the passage of obnoxious legislation.

As far as the rank and file of the retail drug trade is concerned, the handling of narcotic drugs is a hereditary feature of its business naturally acquired. It is an accommodation to the medical profession. If by any other way than over the counter of the retail drug-

store legitimate individual requirements of narcotic drugs and their compounds and preparations could be made available to the ultimate consumer, this branch of the industry would surrender the franchise with scarcely a ripple of protest.

The Anti-Narcotic Law has stopped the open, indiscriminate distribution of cocain and the opiates. To what extent it will prevent the underground traffic, the smuggling, and the leaks that occur through unscrupulous dealers, will depend on the activities and resourcefulness of the enforcing officers, as well as on the moral support and sympathy of the population at large. We have already discussed the broad features of the situation in an earlier chapter, and have noted the extent to which addiction is prevalent in this country. One effect of the law has been practically to eliminate the dispensing pharmacist as a factor in the further spread of the evil. The responsibility is now largely in the hands of the medical profession, and indirectly up to the manufacturing chemist and the makers of medicines who, in the natural course of their operation, prepare enough only for their trade requirements in the shape of orders which, as far as they know, are bona-fide. The manufacturer of proprietary remedies is not at all a factor in the sale of narcotics. He could not be if he had any desire to further this traffic. He is absolutely shut off under the provisions of the Harrison Act.

How far it is incumbent upon the manufacturing chemist or the maker of medicines, from a moral point of view, to ascertain the purpose for which his wares are destined, is a question that cannot be debated here.

The determination of the ultimate destination and purpose of an order of narcotics is usually difficult. In the case of alcoholic medicines the case is different, as we shall see in discussing the Prohibition Law, and the manufacturer has very little difficulty in surmising the purpose indicated by the orders of his customers. But with narcotic drugs and medicines the case is different, and the moral obligations are necessarily more obscure.

Viewed from all aspects and taken by and large, the Narcotic Act has had a distinct beneficial influence on the drug industry.

We now come to the most recent, and at the same time the most revolutionary, piece of legislation that has affected the drug industry since its establishment on the present basis of the relationship of one branch of the trade to another. The eighteenth Amendment, and the Volstead Act, enacted for the purpose of carrying out its spirit, and the intricate regulations drafted to enforce its provisions, have affected the drug and medicine industry from top to bottom, save, perhaps, the dealer in crude drugs alone.

Its immediate effect has been to transfer the handling of the liquor traffic to the drug trade, an adoption that the latter has by no means been keen to accept. An industry, already overburdened with a multitude of formalities that it was obliged to observe in the legitimate conduct of its business, suddenly found itself the foster-parent of a full-grown, obstreperous, and somewhat execrated orphan, already encumbered with legislation, and admonished to provide for its welfare but to keep it out of trouble. It

has been a big order, and the adjustment has not yet been accomplished.

Not only has the drug trade been charged with the responsibility of handling alcoholic beverages, but, being itself a large consumer of alcohol, it has been overwhelmed with a mass of new rules and regulations affecting the employment of this commodity in the conduct of its own business.

It was an unfortunate circumstance that the framers of the Prohibition Law either were unable or did not want to appreciate the significance of alcohol as an essential element of certain types of medicines, and as a necessary manipulative agent in the preparation of a vast number of drugs and medicinal chemicals. The provisions of the law made no distinction between those preparations designed to aid the sick and those that were for pleasurable purposes. The proscriptions on the traffic applied to both impartially.

The belief that many alcoholic medicines were disguised liquors, and that the chief virtue of alcohol-containing remedies lay in the alcohol, was generally current among those who had not taken the pains to learn the real status of medicine compounding. No doubt these ideas prevailed in the minds of those engaged in framing the legislation. In any event, the situation has been brought about that the manufacture and sale of such a potent and toxic medicinal agent as fluid extract nux vomica is surrounded with the same elaborate supervision and regulation that obtains in the making and selling of the wine of the communion-table.

We have already, in an earlier chapter, attempted to

outline the established place that alcohol occupies in relation to the drug and medicine industry, and have shown the fallacy of a popular idea that certain types of remedies enjoying an unrestricted sale were disguised beverages. We need not go further into this phase of the subject, but the points have been recalled because they have a direct bearing on the application of the Prohibition Law to medicines, and the mistaken notions concerning their significance no doubt influenced to a considerable degree the construction of the bill.

The going into effect of the law transferred the sale of alcoholic beverages from the liquor industry to the wholesale and retail drug trade. It also had the converse effect of bringing into existence a host of new druggists and medicine manufacturers through a metamorphosis in the status of a majority of the firms previously engaged in handling liquor. The result was that the country became flooded with a number of extraordinary preparations masquerading as medicine. They were prepared by virtue of legitimate permits granted by the Bureau of Internal Revenue, but the vehicular constituents, which often consisted of whisky or wine, were usually more appreciable than the medicating agents. Moreover, the makers would often substitute in the formulas products that did not comply strictly with the ingredients they had declared when applying for their permit at the Bureau. As an illustration, we will refer to the situation that developed in connection with a class of these new products of the type of tonic-laxatives.

Authority was given to manufacture these prepa-

rations, with their medicinal value and non-beverage character based on the presence of a definite dosage of the drug known as cascara. When straight cascara or its fluid extract functions in a preparation, the physiological effect of the drug on both the palate and the intestines bespeaks its presence. Had the manufacturers of the new products confined themselves to the use of the straight drugs, the scandalous conditions that soon developed would have been avoided. But the market is bristling with a great variety of so-called "tasteless," "bitterless," and "aromatized" cascaras, and with other forms claiming to feature the drug in a manipulated state. Virtually all of them are unobnoxious from the standpoint of bitterness, which, as we all know, is one of the characteristic properties of unadulterated cascara. Substitution of these products in place of straight cascara soon became a wholesale practice, with the result that the "unfit-for-beverage purpose" character of the new preparations disappeared, and they were consumed in enormous quantities to satisfy the craving for liquor.

The entire drug industry suffered disrepute on account of these conditions; but fortunately the administrative officers appreciated the situation, so that, with the renewals of the permits for doing business in 1921, the offending products had to fall into line as true medicines or else retire from the market.

A literal interpretation of the law would tend to prevent the indulgence in some of the well known household prescriptions—such as beef, iron, and wine, a favorite tonic during convalescence; Jamaica ginger, the panacea for green-apple days; essence of pepsin

and lactated pepsin, those yellow and pink reliefs for the results of our offenses against gastronomy—because such products are not disagreeable to the taste and, strictly speaking, might fall into a class that is fit for beverage purposes. Then, there is an important class of remedies known as the reconstructive tonics, which may vary considerably in composition, depending on the purposes for which they are to be used or the idiosyncrasies of the patients, but which have this property in common, that in general they are quite palatable. They have to be pleasant to take, because they are consumed in fairly large dosage, often a wineglass or more at a time; this is necessarily so because of the dilution of the active medicinal agents in solution. The virtue of a tonic in convalescence is that it provides relatively small amounts of medication at each ingestion, but at fairly frequent and consistent intervals. At such times the patient's system is in a sensitive state, so that a tonic remedy must be of such character that it will not be obnoxious to the stomach or objectionable to the organs of taste and smell.

The administrators of the law have assumed a liberal attitude toward these remedies, though there has been ample evidence that in some quarters they have been sold and used for other than remedial purposes. As a rule, the unlawful traffic has been a connivance on the part of mushroom firms and has been no part of the business of the old-line houses. In fact, the established trade in all its branches has given the Prohibition officers its support and assistance ungrudgingly, in spite of the fact that the new order of

things has added an increased amount of burden and detail to the conduct of its affairs.

The trade itself is, perhaps, in a better position to know whether its products are being diverted to unlawful purposes than are the Prohibition officials. When preparations become popular for the satisfaction they impart because of the alcohol they contain, the consumption increases out of all proportion to legitimate medical requirements, and there is no difficulty in accounting for the abnormal popularity. For instance, it is customary to supply the retail customer with liquid preparations packed in bottles holding not more than a pint. There is, of course, considerable business in large packages, gallons and even barrels, but in the aggregate the bulk of the traffic is limited to the family size. Therefore, when small dealers, country stores, and cross-roads centers begin to order beef, iron, and wine, Jamaica ginger, bay rum, and essence of pepsin in barrel quantities, and to follow up their purchases week after week, there is no doubt about the ultimate purpose for which they are destined. The trade has a moral responsibility, as a law-conforming body, to limit this sort of traffic, and the administration feels that it has a right to expect this coöperation.

With the advent of national prohibition, certain changes occurred in the regulations pertaining to the use of denatured alcohol, and its use in the drug industry has become greatly extended. Before that time it had been the practice to restrict the use of denatured alcohol in medicines to the preparation of those articles where the alcohol did not function in the

finished product. There had been an exception in the case of tincture of iodin and a few liniments that could be made up with a highly denatured formula. Tincture of iodin and liniments are unfit to drink anyway, so it was not difficult to adjust their formulation to the use of special formulas of denatured alcohol.

Soon after the Volstead Act was passed, the extension of the use of denatured alcohol to all sorts of external remedies became the policy of the Bureau of Internal Revenue, and was quite generally taken advantage of by the trade. Hair-tonics, shampoos, antiseptic washes, dentifrices, lotions, toilet waters, and finally perfumes were gradually included within the privileged circle.

The trade that has been able to take advantage of the use of denatured alcohol has been to that extent free from the uncertainties and perplexities that attend the employment of the pure spirit or, as it is termed, non-beverage alcohol. Furthermore, this alcohol is free from tax, a not unimportant item in the cost of doing a year's business, especially if it runs into many carloads of alcohol.

One of the minor pieces of legislation affecting the drug industry is the act of July 1, 1902, licensing the manufacturing of serums and vaccines under the supervision of the Public Health Service. Prior to that time anyone could engage in the preparation of these delicate prophylactic and curative agents, and the articles produced by some of the firms in the business were often lacking in certain desirable characters. Accidents had happened through infection by foreign organisms. Smallpox vaccine had been contaminated

with tetanus microbes, resulting in dire consequences to the patient under inoculation. Inert and attenuated vaccines and serums were not uncommon, and many painful experiences had been reported following the use of anti-toxin that had not been properly sterilized.

When it is realized that these substances have to be made under conditions that will assure their absolute asepsis, it is apparent that they should be manufactured only by those firms possessing the proper talent and intelligence to conduct the intricate processes necessary to evolve products of unquestionable character.

Government supervision of the manufacture of vaccines and serums has proved as great a benefit to this industry as the operation of the meat inspection service has to the packing trade.

Reference has already been made to the activities of the Bureau of Biological Survey in controlling the indigenous predatory wild animals. The work accomplished has been in the interest of the public health and the stock-raising industry, and cannot be said to have had any direct influence on the drug trade, except in so far as it benefits the manufacturing chemist providing the strychnin and saccharin. In the same way, the federal quarantine regulations affecting the handling of stock on the ranges during growth and before shipment to market have been instrumental in developing an enormous demand for chemical dips and antiseptics.

The legislation of the past two decades has had a beneficial effect on the public health, and no doubt, to some extent, has resulted in an improvement in business morality. Its direct influence on the drug

and medicine trade, while often hampering in the extreme, has in its broader aspect been wholesome, though if the retail druggist were asked his opinion he would probably hold up his hands and shake his head. But it has purged the fraternity of some of its crooks and curbed their nefarious practices, which alone was worth while.

The conduct of the retail drug business has been invested with a multitude of municipal ordinances and State regulations regarding the practice of pharmacy. As each and every new law has been written on the statute-books, a host of new proscriptions have descended on the proprietor of the corner drug-store, until to-day compliance with the multifarious details of regulations requires the keeping of a small library of blanks and forms, and the rendering of voluminous reports to city, State, and federal authorities, as well as eternal vigilance to prevent the innocent overstepping of the law by clerks and other retainers. The day of the old-fashioned pharmacist has gone, much as his passing may be regretted. He has joined the lost races at a comparatively recent date, coincident with the passing of the buffalo and the wild pigeon from the native fauna.

In place of this revered and truly professional character in the business life of the nation has come one no less respected, and clothed not with less but with many times the responsibility—a business man whose professional leanings and ability have to take second place to commercial sagacity and auditorial acumen.

It would seem as if the drug trade had become involved in about all the various types of legislation that

could possibly be imposed upon it. The temper of the public made the larger federal measures inevitable. The State laws are necessary, and municipal ordinances will ever be a feature of our political complexion.

In time the efforts of the patriotic gentlemen high in the councils of our medical and pharmaceutical professions will bring about a uniformity in the laws regulating the practice of pharmacy, smooth out the rough places and inconsistencies in federal regulations, develop a tolerance on the part of the local health officers and boards of health, and a realization that untimely and senseless restrictive rules have no place in the onward progress of our economic life.

APPENDIX

The Family Medicine-Chest
or
Household Armamentarium

Acetic Acid, Glacial (for warts)
Alcohol
Alcoholic Lead Acetate (for ivy and sumac poisoning)
Alum
Ammonia Water
Aromatic Spirit of Ammonia
Asthma Relief
Beef Extract
Blackberry Cordial
Boric Acid
Brandy
Bromo Seltzer or Capudine (for headache)
Camphocene (for cold-sores and fever-blisters)

NOTE. Neither the author nor the publishers hold any brief or recommendation for the efficacy of the remedies in the appended list. Either these medicines or those of similar type and character are in daily use in the households of the country. Some are now virtually national institutions, and the mention of them by name carries no greater significance than would a reference to Rolled Oats, Baker's Chocolate, Gold Medal Flour or Fleischmann's Yeast. The ingredients composing these remedies are recognized by the authorities of the medical profession as being indicated in the conditions for which they are intended, and the list in the aggregate, represents the type of supplies that the people themselves have settled upon for their own use, and as first aid to the doctor when he is called in an emergency.

Camphorated Oil (externally for sore throat, congestion in chest, etc.)
Camphorated Tincture of Opium (Paregoric)
Capsicum Plasters
Capsules Chloretone, 5-grain (for seasickness)
Capsules Cod-Liver Oil
Carbolated Vaseline
Carron Oil (for burns)
Castoria
Castor Oil
Chalk Mixture
Chloranodyne
Clam Bouillon
Collodion
Compound Licorice Powder
Compound Tincture of Gentian
Corn Remedy
Court Plaster
Cough Syrup—Goff's, Foley's Honey and Tar, or some other equally good brand
Dandruff Remover and Hair Wash
Dioxogen (or any brand of hydrogen peroxide)
Dilute Carbolic Acid
Distilled Extract Witch Hazel
Dover's Powder
Ear Syringe
Elixir Buchu Juniper and Potassium Acetate
Elixir Heroin and Terpin Hydrate
Elixir of Salicylates
Emergency Surgical Outfit, Red Cross
Extract of Jamaica Ginger
Female Tonic. Wine of Cardui, Pinkham's Vegetable Compound or similar preparations.

Flax-Seed Meal
Fluid Extract Grindelia (for ivy poison)
Fluid Extract Cascara
Globules Colchicin and Methyl Salicylate
Glycerin
Glycerin Suppositories
Glycerite of Tannic Acid (for an astringent gargle)
Glycothymoline or some other alkaline antiseptic wash
Granular Effervescent Magnesium Citrate
Granular Effervescent Sodium Phosphate
Hoffmann's Anodyne
Hypodermic Syringe and Needles
Ichthyol Ointment (for eczema)
Lapactic Pills
Laxative Bromo-Quinin (for colds and fever)
Liquid Petrolatum (Albolene)
Listerine or some other acid antiseptic wash
Lysol (for general antiseptic purposes, sanitary douching, etc.)
Malted Milk
Mentholatum (for piles, sore throat, congestion of the nasal passages, etc.)
Menthol Inhaler
Mercurial Ointment (for external parasites, itch-mites. etc.)
Milk of Magnesia
Mixture Rhubarb and Soda (for diarrhea and summer cholera)
Mustard Plaster
Nasal Douche
Oil of Citronella
Oil of Cloves
Pearls of Amyl Nitrite (for cramps and fainting)
Pile Ointment

Pills, Blaud's Mass, 5 grains
Pills, Podophyllin $1/10$ grain (for torpidity of the liver)
Pills, Quinin Bisulphate $2\frac{1}{2}$ grains (for malaria)
Potassium Permanganate Crystals (for snake-bite)
Prickly-Heat Powder
Resinol Ointment
Rheumatism Remedy
Sal Hepatica (aperient and saline laxative)
Sarsaparilla or Alterative Mixture (Blood Purifier)
Scott's Emulsion
Seidlitz Powder
Soap Liniment
Sodium Bicarbonate (cooking soda)
Sodium Bromide
Solution Argyrol—25 per cent. (germicide and for aborting nasal colds, especially in children)
Solution Boric Acid, Saturated (for bathing the eyes)
Solution Iron Chloride (for nose-bleed and for mixing with ammonia and milk of magnesia as an antidote for arsenic poisoning—"Rough on Rats")
Spirit of Camphor
Spirit of Nitrous Ether (for fever)
Sulphur Flowers
Syrup of Iron Iodide
Syrup White Pine and Tar
Tablets, Aloin, Belladona, Strychnin, and Cascara (for general laxative purposes)
Tablets, Antipyrin $\frac{1}{2}$ grain (for whooping cough)
Tablets, Aromatic Digestive
Tablets, Aspirin 5 grains
Tablets, Calomel, $\frac{1}{4}$ grain
Tablets, Camphomenthol (for coughs and tickling of the throat)

Tablets, Chlorozene (for preparing antiseptic douche)
Tablets, Normal Saline Solution (for nasal douche and gargle)
Tablets, Soda Mint
Tablets, Sun Cholera Mixture
Tablets, Uterine Astringent and Antiseptic (for preparing douche for vaginal catarrh, etc.)
Tablets, Veronal
Talcum Powder, Borated
Tannic Acid Crystals (for an astringent and for nose-bleed)
Throat Lozenge
Thymol Iodide (Aristol)
Tincture of Aconite (for fever)
Tincture of Arnica
Tincture of Iodine
Tincture of Myrrh (astringent for spongy gums)
Toothache Wax
Vaseline, or Petrolatum
Vermifuge—Some mixtures in liquid form like Jayne's or other good brand.
Vick's Vaporub
Whisky
Witch Hazel Jelly (for sunburn and chapped hands)
Zinc Oxide Ointment
Zinc Stearate

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